

Insights into economic impacts from climate change in Venice

Margaretha Breil

Fondazione Eni Enrico Mattei

ACT Conference
Ancona, December 2010



Impacts in Venice

Breil

Assessments
of costs
related to Sea
Level Rise

Strategy of
assessment

Buildings
Commercial
activities

Results

Building
structures
Commercial
activities

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 - Buildings
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 - Building structures
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Different assessments with different details for each scale:

- Large scale (PESETAS): interactions between adaptation measures and global change; Adaptation measures designed on Cost-benefit analysis
- National assessments (DELTA COMMISSION) Strategy for the national future; considerations on adaptation measures related to human safety
- Regional (Piana di Fondi, ENEA FEEM); Assessment of economic assets and activities in the area.
- Local (Venice)

Vulnerable areas in Europe

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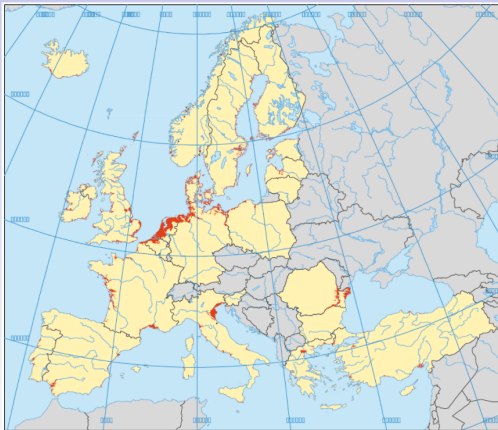
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	Land losses (% of region total)	Coastal Protection Expenditure (% of GDP)	Investment (induced by coastal protection)	GDP
Northern Europe	-0.046	0.040	18.647	0.057
British Isles	-0.006	0.015	7.784	-0.021
Central Europe North	-0.038	0.011	4.685	-0.069
Central Europe South	-0.007	0.007	3.384	-0.126
Southern Europe	-0.015	0.010	4.016	-0.062
Europe	-0.026	0.012	5.542	-0.062

All values expressed as % changes with respect to A2 2085 baseline except coastal protection expenditure in % of GDP

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Economic damages assessed:

- Damages from flooding:
 - ▶ Buildings structures (residential and commercial uses)
 - ▶ Commercial activities
- *Tourism*
- *Fisheries*
- *Harboractivities*

(Vector Cliven) "Valuation of climate change impacts on the historic centre of Venice: buildings and economic activities"

Economic damages assessed:

- Damages from flooding:
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(Vector Cliven) "Valuation of climate change impacts on the historic centre of Venice: buildings and economic activities"

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- Using present damages caused by high water to assess future costs
 - Assessing increased maintenance costs due to high water
 - Using upper and lower bound values for cost assessments
 - Creating scenarios: increasing levels of inundation

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High water in Venice

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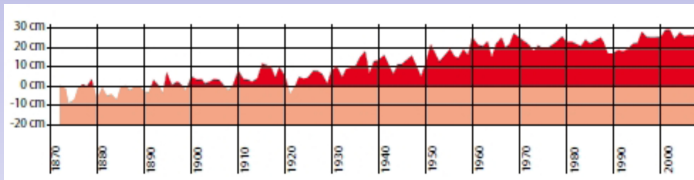
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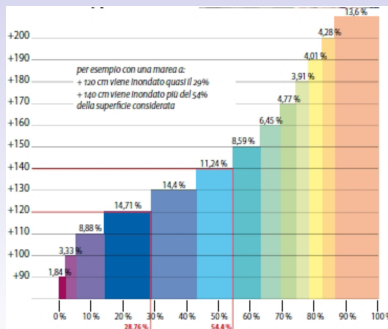
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Comune di Venezia, Centre for Tidal Forecast



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- Existing database on ground floor units (local authority)
- Information from experts from constructions sector
- Historic data on tide frequencies and levels

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Database

Creation of the sample

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Criteria for selection:

- surveyed from inside
- information on base level or level of inundation available

Creation of the sample

Type of uses	DB	Sample	Percentage
Residential	3140	2425	77,2%
Commercial ^a	4709	2598	55,17%

^aCommercial uses comprise resales, production, offices, public services

Description of the sample

Levels of inundation

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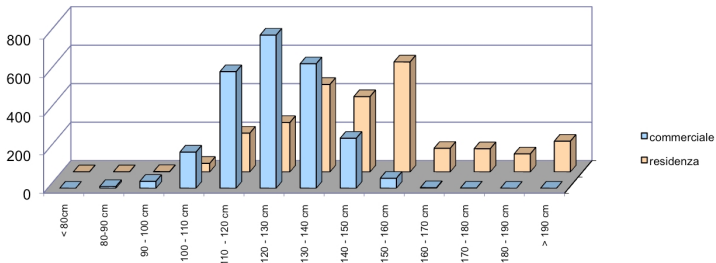
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Quote di allagamento



Assessment

Categories of costs considered

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Fixed costs

do not change with inundation frequency
(mainly protection measures)

Variable costs

depend on the frequency of inundation
or on the elevation above the tidal gauge
(mainly structural building elements)

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Elements considered among fixed costs

- raising floor levels
- barriers
- impermeabilization
- pumps
- horizontal barriers

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Elements considered among variable costs

- Doors
 - ▶ external doors
 - ▶ internal doors
- Walls
- Floors

(Information on furniture was not available)

Identification of

- damages/increases in maintenance costs for each building element
- function of protection measures for the mitigation of damages
- applying specific damage functions to each ground floor unit

$$CP = \sum_i \sum_j (CPI^i(e_j(p, q)) + CPE^i(e_j(p, q)))$$

where:

- CP costs due to deterioration of doors due to high water;
- CPI costs for internal doors;
- CPE costs for external doors;
- i identifies the unit of the sample;
- j level of inundation
- e_j annual number of events at the level of inundation j
- p depending on the type of protection p if existing,
- q and on the quota q of the unit.

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Medium annual frequencies

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Scenario tide level	BAU defence		+10 cm defence	
200- 210 cm	0,02	0,00	0,02	0,00
190 -200 cm	0,02	0,00	0,02	0,00
180 - 190 cm	0,02	0,00	0,02	0,00
170 - 180 cm	0,02	0,00	0,05	0,00
160 - 170 cm	0,05	0,00	0,07	0,00
150 - 160 cm	0,07	0,00	0,19	0,00
140 - 150 cm	0,19	0,00	0,60	0,00
130 - 140 cm	0,60	0,00	1,50	0,00
120 - 130 cm	1,50	0,00	3,52	0,00
110 - 120 cm	3,52	0,00	8,83	0,00
100 - 110 cm	8,83	8,83	21,24	21,24
90 - 100 cm	21,24	21,24	53,50	53,50
80 - 90 cm	53,50	53,50	129,05	129,05
70 - 80 cm	129,05	129,05	255,38	255,38

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Interviews to a representative sample of approx. 900 operators

Reference:

- exceptional high water 16/11/2002 (147 cm above tide gauge)
- scenario of one week of medium-high tides (110 - 120 cm)

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Economic activities denounce damages from

- structural damages to furniture, floors, walls (75%)
- lack of takings (85%)
- cleaning up and securing merchandises (91%)
- psychological stress (87%)

Fixed costs

(actual costs, no scenario for change) €(2008)

	commercial units	residential units	all
medium costs	10.543	9.309	9.947
compl. costs	63.237.178	40.780.711	104.017.889

Annual costs from structural damages (€ 2008)

estimation scenario	low		high	
	no defence	defence	no defence	defence
BAU	4.744.265	6.557.747	2.959.763	4.119.866
SLR + 10	7.466.935	9.533.959	4.517.692	5.143.753
variation (€ 2008)	2.722.670	2.976.213	1.557.929	1.023.886
variation (%)	57,39%	45,38%	52,64%	24,85%

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Results

Types of costs from a single event

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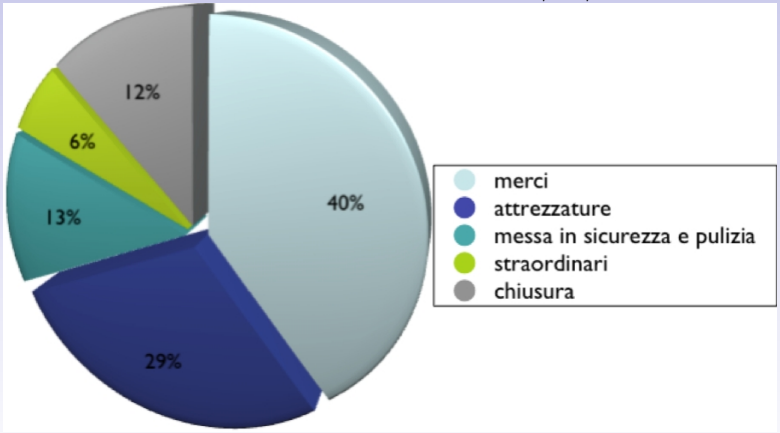
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Percentages of costs from the high water 16/11/2002



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Scenario
tide level

BAU

defence

+10 cm

defence

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200- 210 cm	0,02	0,00	0,02	0,00
190 -200 cm	0,02	0,00	0,02	0,00
180 - 190 cm	0,02	0,00	0,02	0,00

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170 - 180 cm	0,02	0,00	0,05	0,00
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160 - 170 cm	0,05	0,00	0,07	0,00
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150 - 160 cm	0,07	0,00	0,19	0,00
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Results

€11.842.000

140 - 150 cm	0,19	0,00	0,60	0,00
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130 - 140 cm	0,60	0,00	1,50	0,00
--------------	------	------	------	------

120 - 130 cm	1,50	0,00	3,52	0,00
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110 - 120 cm	3,52	0,00	8,83	0,00
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100 - 110 cm	8,83	8,83	21,24	21,24
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90 - 100 cm	21,24	21,24	53,50	53,50
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80 - 90 cm	53,50	53,50	129,05	129,05
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70 - 80 cm	129,05	129,05	255,38	255,38
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Results

Types of costs from a week of medium high tides

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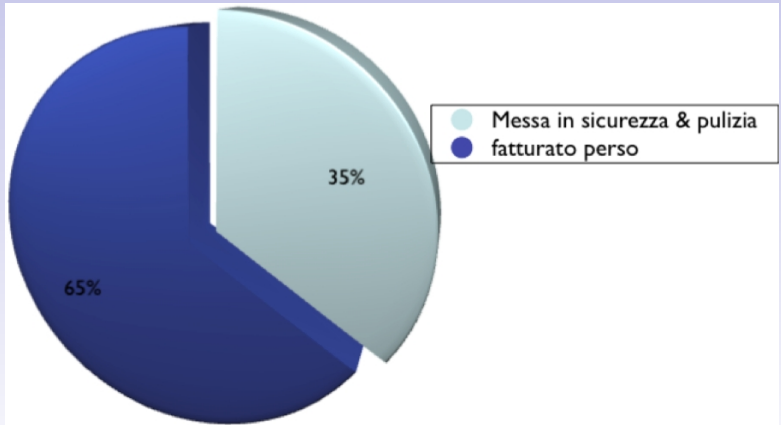
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Additional annual costs of +10 cm SLR (Millions €)

	Under current protection measures	3	With full protection up to 110 cm	1
Structural damages	2.7	3	1.5	1
Commercial Activities (1 week)	2.4		2.5	
Commercial Activities (1 event)	4.9		-	
Total	9.9	10.3	4.1	4

Cost of additional 5 events of 110 - 120 cm (yearly average):
6.6 million €

Cost of a single event of 140 - 150 cm (16 IX 2002):
11.8 million €

With increase of frequency of events of this importance:
annual costs from 2.25 to 7.1 million €

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Thank you!