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Land and sea use interaction in Heraklion coast

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FORTH

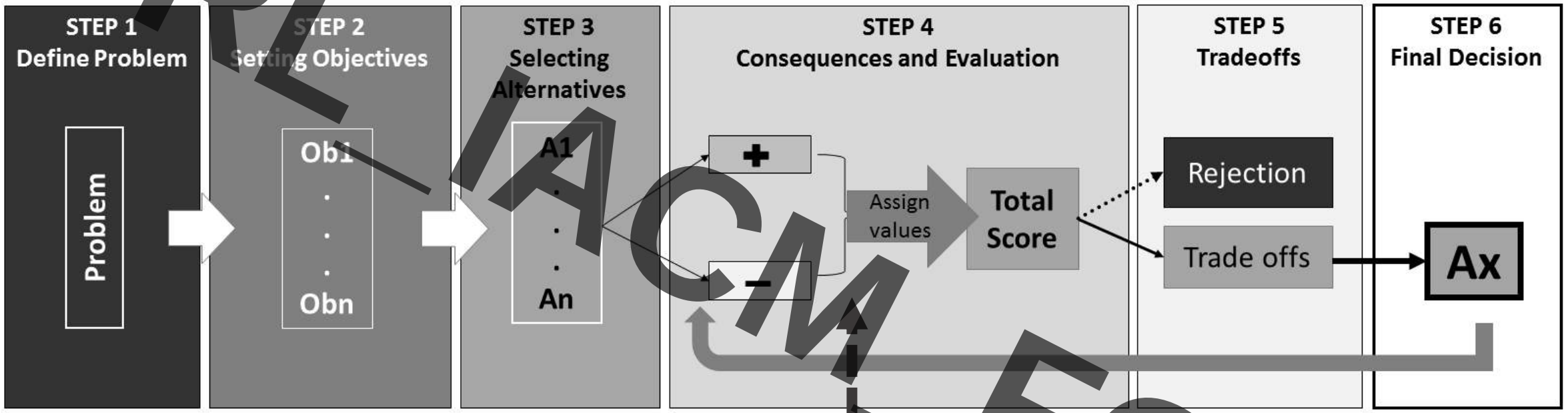
SCOPE

- **Motivation**
  - Directive 2014/89/EU: enact and implement MSP at the latest by 31 March 2021
  - Particularities of maritime areas, existing and future activities and uses and their environmental impacts and also Land-Sea interactions
  - Ensure coherence between terrestrial and maritime planning
  - Develop a method to assess the interaction between future land and sea uses

- **Objectives**
  - Identify the interactions between changes in the land and sea uses (Case study the wider Heraklion area, Crete, Greece)
  - Quantify the consequences arising by the implementation of a series of projects

METHODOLOGY

Structured Decision-Making Approach → codified process



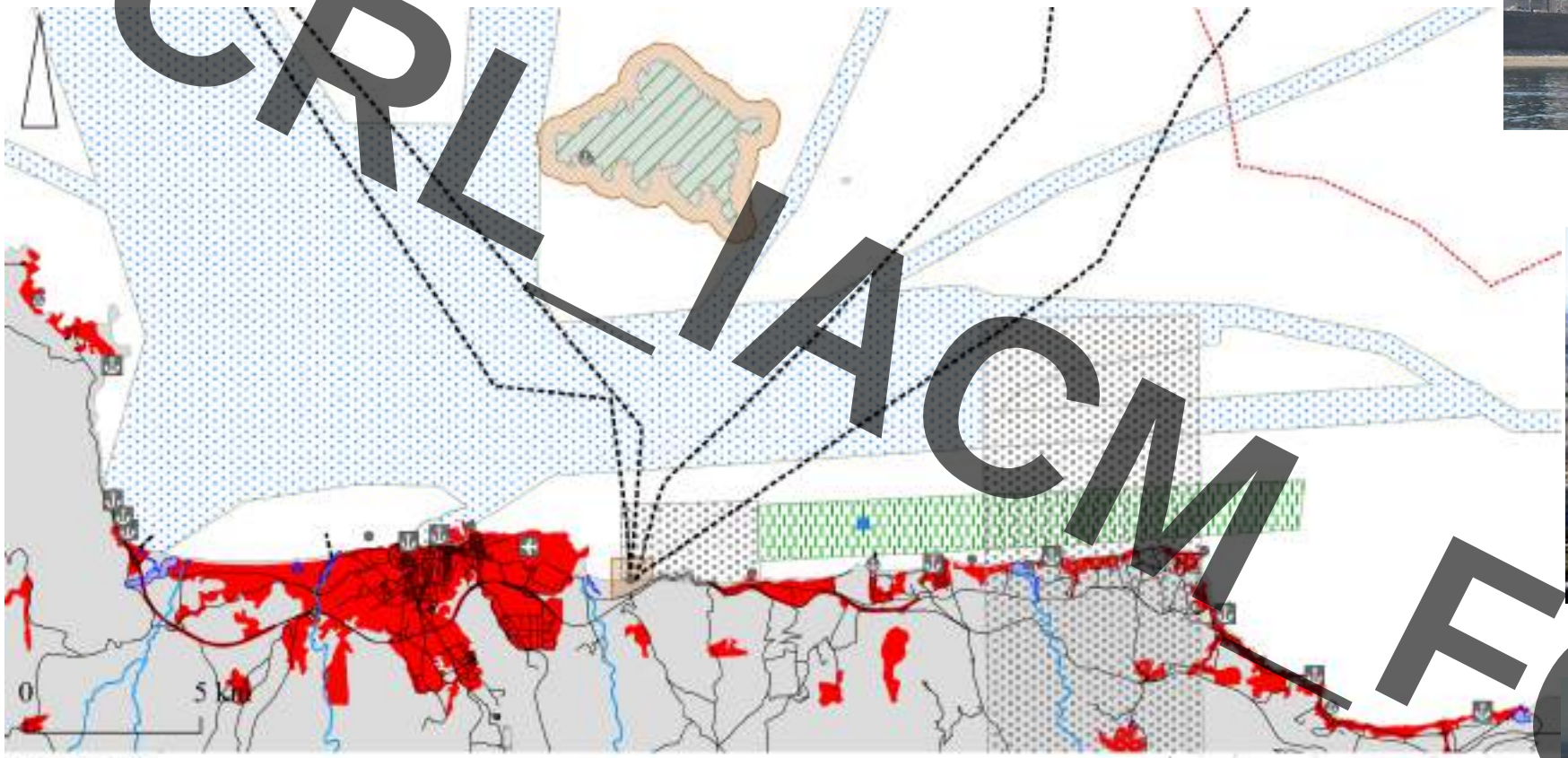
Quantification of the consequences with the use of a likelihood and severity matrix

Likelihood \ Severity	1	2	3
1	2	3	4
2	3	4	5
3	4	5	6

$$SC_{Ai} = \sum_{0}^{n} c_n$$

Where: SC: overall score of the alternative
Ai: the alterative
Cn: consequence score

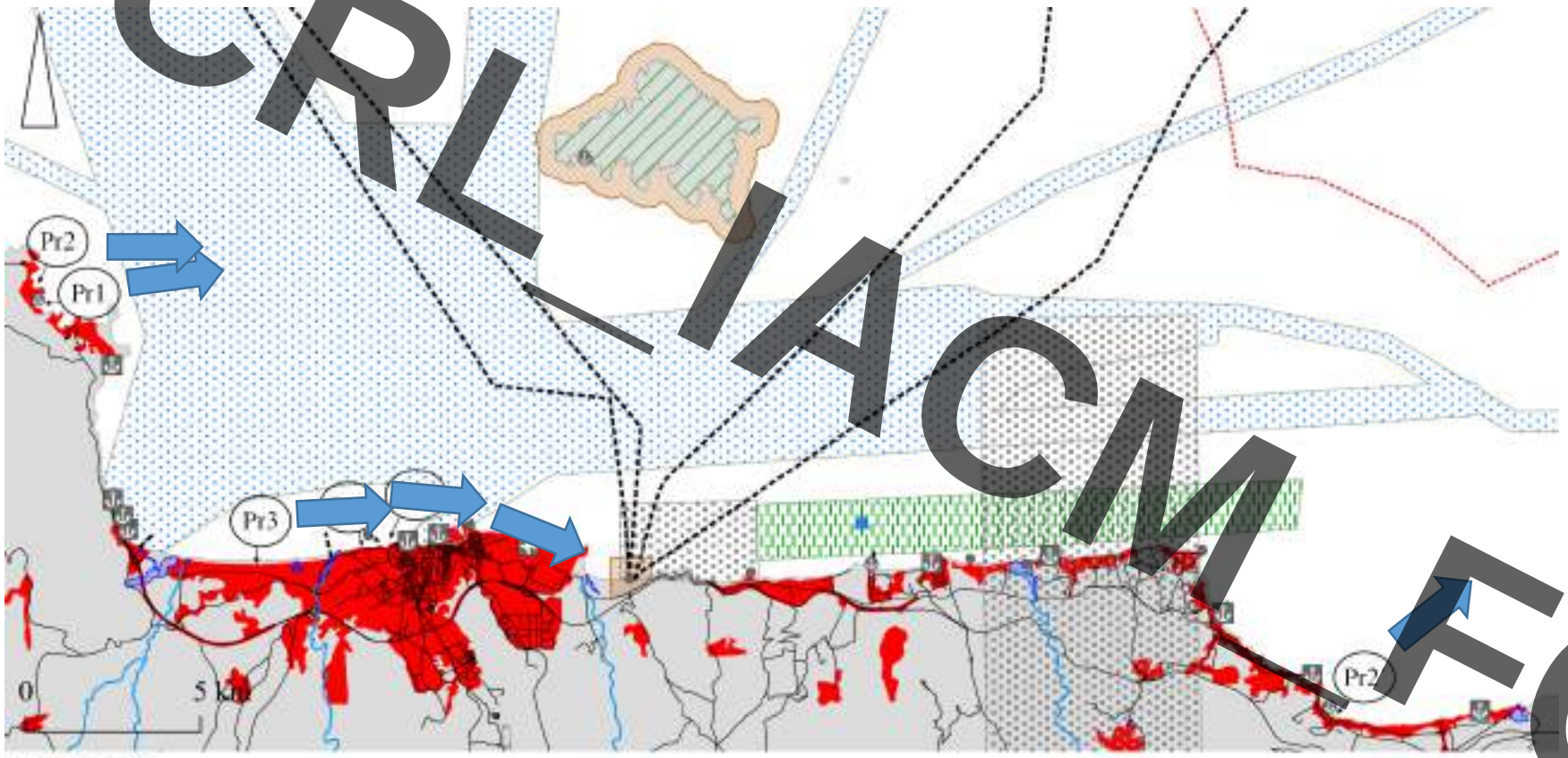
CASE STUDY



LEGEND

- Airport
- Port infrastructure
- Anchorage
- Underwater biotechnological park
- Underwater antiquitie
- Cables and pipelines
- Territorial sea
- Road network
- Natural fluvial system
- Corine 2012 - Artificial surfaces
- Military area
- Shipping area
- Natura 2000
- Island wetlands
- Posidonia oceanica
- Archaeological site

CASE STUDY



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Pr1: Beach nourishment & breakwater

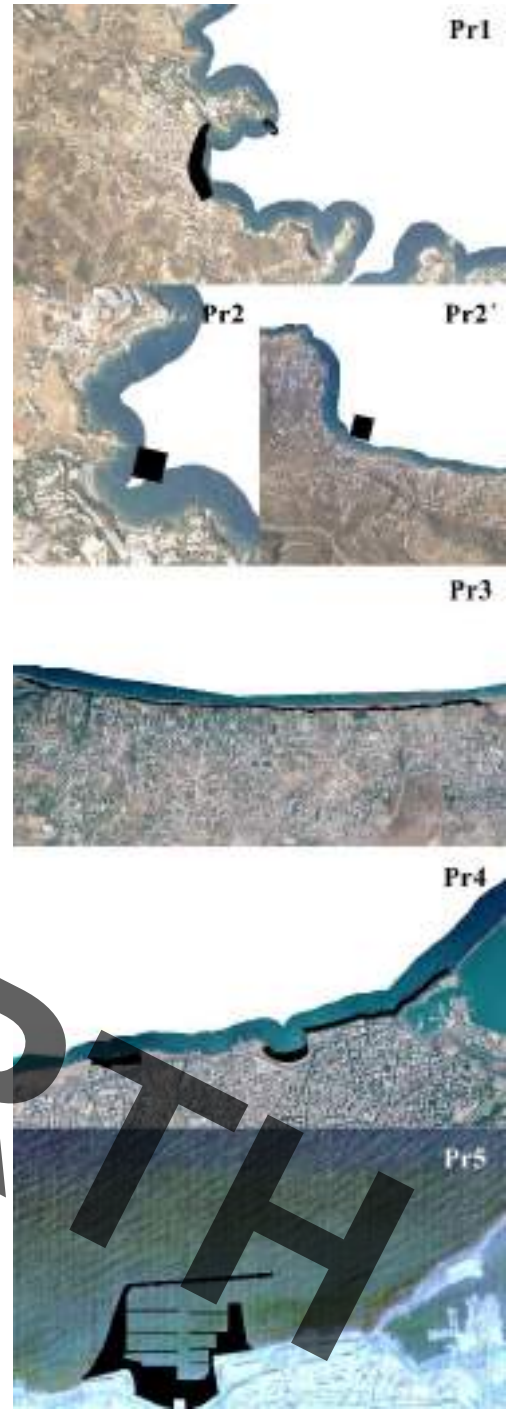
Pr2: Diving park

Pr2´: Diving park (alternative)

Pr3: Regeneration

Pr4: Beach nourishment & breakwater

Pr5: Tourist marina



CASE STUDY

STEP 1

«Can the proposed intervention projects of the coastal area of Heraklion contribute to the achievement of environmental, economic and social goals?»

STEP 2

Ob1	**Ob2**	**Ob3**
Protection of the Venetian walls	Aesthetic improvement of coastal area	Tourism development

STEP 3

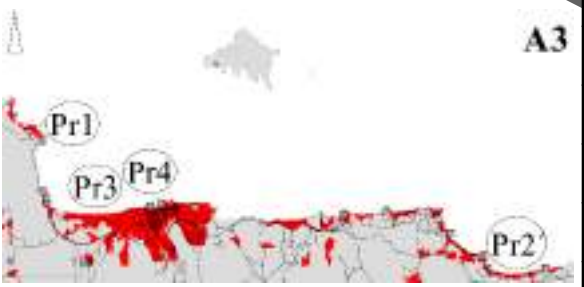
A1	**A2**	**A3**	**A4**	**A5**
No action	Pr1	Pr1	Pr1	Pr1
	Pr2	Pr2´	Pr2	Pr2´
	Pr3	Pr3	Pr3	Pr3
	Pr4	Pr4	Pr4	Pr4
			Pr5	Pr5

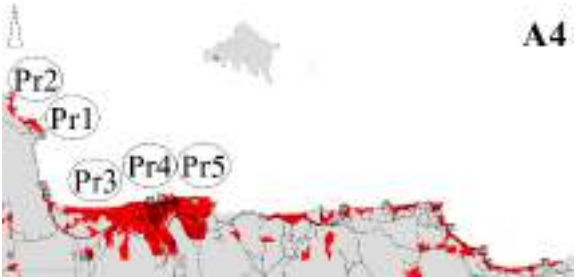
RESULTS

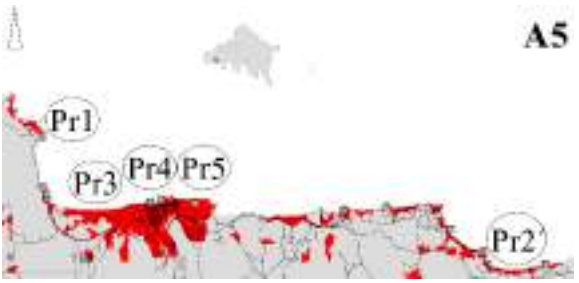
Consequences	A1		
	L	S	T
Non altering the physiogeografic of the coastal area	3	3	**6**
Erosion of Venetian walls (cultural heritage degradation)	-3	-3	**-6**
Coastal erosion	-3	-3	**-6**
Infrastructures degradation	-2	-3	**-5**
Aesthetic and functional degradation	-2	-3	**-5**
Reduction of visitors	-2	-3	**-5**
Loss of income	-2	-3	**-5**
Loss of jobs	-2	-1	**-3**
High costs to repair damage (recurrent)	-3	-3	**-6**
Total	**-16**	**-19**	**-35**

Coastal erosion in Dermata bay

RESULTS







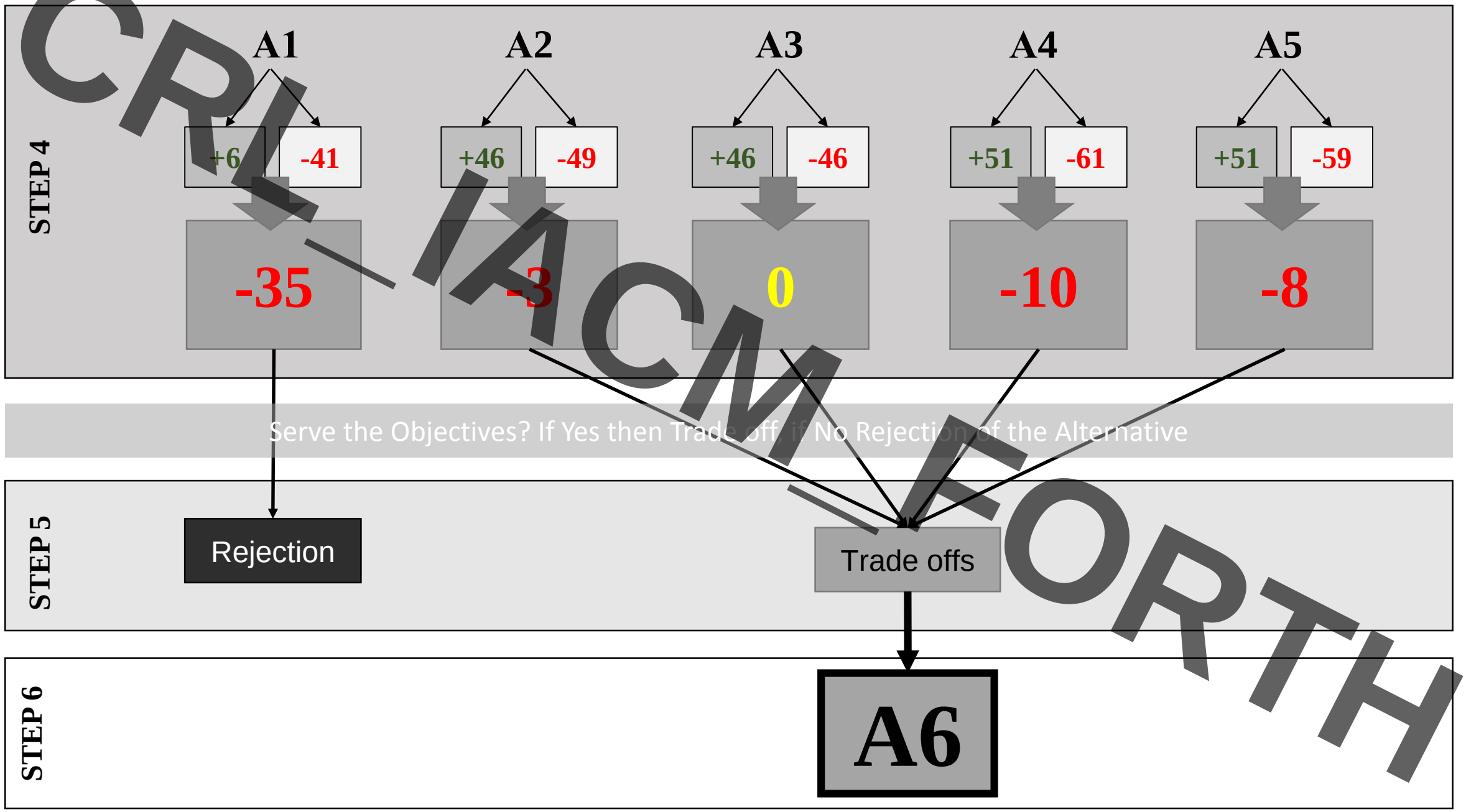
Consequence	A2			A3			A4			A5		
	L	S	T	L	S	T	L	S	T	L	S	T
Protection of Venetian walls (erosion)	3	3	**6**	3	3	**6**	3	3	**6**	3	3	**6**
Protection of coastal infrastructures	3	3	**6**	3	3	**6**	3	3	**6**	3	3	**6**
Upgrade of port infrastructures	-	-	-	-	-	-	3	2	**5**	3	2	**5**
Tourist product enhancement	3	2	**5**	3	2	**5**	3	2	**5**	3	2	**5**
Aesthetic upgrade	3	2	**5**	3	2	**5**	3	1	**4**	3	1	**4**
Increase in visitors	3	3	**6**	3	3	**6**	3	3	**6**	3	3	**6**
Increase of income (during the construction)	2	2	**4**	2	2	**4**	2	3	**5**	2	3	**5**
Job creation (during the construction)	2	2	**4**	2	2	**4**	2	2	**4**	2	2	**4**
Increase of income (after the construction)	2	3	**5**	2	3	**5**	2	3	**5**	2	3	**5**
Job creation (after the construction)	2	3	**5**	2	3	**5**	2	3	**5**	2	3	**5**
Environmental degradation during the construction	-2	-1	**-3**	-2	-1	**-3**	-3	-2	**-5**	-3	-2	**-5**
Degradation of cultural heritage (construction of the marina)	-	-	-	-	-	-	-3	-3	**-6**	-3	-3	**-6**
Costs of interventions	-3	-2	**-5**	-3	-2	**-5**	-3	-3	**-6**	-3	-3	**-6**
Increase in car traffic	-3	-2	**-5**	-3	-2	**-5**	-3	-2	**-5**	-3	-2	**-5**
New needs for infrastructures (eg. parking, transport connections)	-3	-2	**-5**	-2	-2	**-4**	-3	-3	**-6**	-3	-2	**-5**
Supplementary costs for new infrastructures	-3	-3	**-6**	-3	-3	**-6**	-3	-3	**-6**	-3	-3	**-6**
Erosion of Ammoudara coast	-3	-3	**-6**	-3	-3	**-6**	-3	-3	**-6**	-3	-3	**-6**
New projects to address Ammoudara erosion	-3	-3	**-6**	-3	-3	**-6**	-3	-3	**-6**	-3	-3	**-6**
Supplementary costs to address Ammoudara erosion	-3	-3	**-6**	-3	-3	**-6**	-3	-3	**-6**	-3	-3	**-6**
Degradation of seawater (marine traffic, bathers wastes)	-2	-1	**-3**	-2	-1	**-3**	-2	-3	**-5**	-2	-3	**-5**
Tourist flows change between antagonizing areas	-2	-2	**-4**	-1	-1	**-2**	-2	-2	**-4**	-2	-1	**-3**

RESULTS

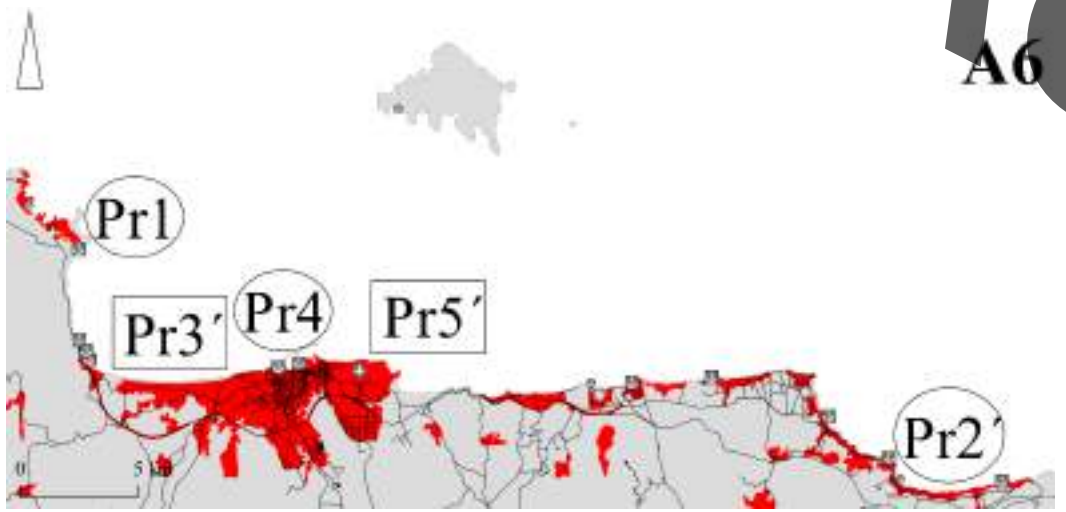
Main land – sea use interactions

- Changes in land and sea uses
- New needs for infrastructures
- Erosion of Ammoudara coast
- Supplementary projects to address Ammoudara erosion
- Tourist flows change between antagonizing areas

RESULTS



RESULTS



Consequence	A6		
	L	S	T
Protection of Venetian walls (erosion)	3	3	**6**
Protection of coastal infrastructures	3	3	**6**
Upgrade of port infrastructures	3	2	**5**
Tourist product enhancement	3	3	**6**
Aesthetic upgrade	3	2	**5**
Increase in visitors	2	3	**5**
Increase of income (during the construction)	2	3	**5**
Job creation (during the construction)	2	2	**4**
Increase of income (after the construction)	3	3	**6**
Job creation (after the construction)	3	3	**6**
Environmental degradation during the construction	-3	-2	**-5**
Costs of interventions	-3	-3	**-6**
Increase in car traffic	-3	-2	**-5**
New needs for infrastructures (eg. parking, transport connections)	-3	-2	**-5**
Supplementary costs for new infrastructures	-3	-3	**-6**
Erosion of Ammoudara coast	-1	-1	**-2**
New projects to address Ammoudara erosion	-1	-3	**-4**
Supplementary costs to address Ammoudara erosion	-1	-3	**-4**
Degradation of seawater (marine traffic, bathers wastes)	-2	-3	**-5**
Tourist flows change between antagonizing areas	-2	-2	**-4**
Total	**5**	**3**	**8**

CONCLUSIONS

- New uses in the coastal area → new interventions will be required
- Fragmented decision-making process
- An holistic approach → reduction of negative interactions
- Integrated methods → terrestrial and maritime space interaction
- Participation of a large number of experts and stakeholders
- The SDM method
  - ✓ Highlights the consequences and the conflicts
  - ✓ Quantify the consequences → strength and weakness
  - ✓ In tradeoff stage an alternative that serve the objectives and minimize impacts can be identified
  - ✓ The strength and weakness of a series of projects can be identified and the longtime sustainability can be further improved

Thank you