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iDEAL - DEcision support for Adaptation pLan

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WP3 DEFINITION AND MONITORING OF CLIMATE ADAPTATION PLANS Activity 3.3 MONITORING SYSTEM

3.3.1 Database of indicators 3.3.2 Monitoring system

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Partners involved:

LP - IRENA – Istrian Regional Energy Agency

PP1 - MUNICIPALITY OF PESARO

PP3 - MUNICIPALITY OF MISANO ADRIATICO

PP4 - CITY OF DUBROVNIK DEVELOPMENT AGENCY DURA

PP5 - REGIONAL NATURAL PARK “COASTAL DUNES FROM TORRE
CANNE TO TORRE SAN LEONARDO”

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1. Introduction

Based on the knowledge provided by climate vulnerability, risk analysis and policies already implemented, Climate Adaptation Plans have been developed for all iDEAL partner, cities or countries. These are going to be adopted by municipalities or counties, thanks to the use of a DSS developed to support decisions regarding climate adaptation measures. Built on these studies, the knowledge and skills acquired by policymakers will have a long lifespan, until they become obsolete, as they will be used in the daily activities of interested policymakers, while the number of inhabitants enjoying climate adaptation planning should increase as a result of a more widespread and refined use of the processed DSS. The progression in implementing the plan has depended heavily on each partner, on the available data, knowledge, and information, but the process that leads to the adoption of adaptation plans is transferable to any other social context facing adaptation to climate changes. The structure defined for the preparation of the climate adaptation plan is the following:



Image 1. Climate Adaptation Plan steps

2. Indicators database

In order to have a contextual and coherent monitoring system with the (5) areas under study, each partner was asked to choose a set of indicators related to the previously selected impacts. Based on these sets of indicators, the effectiveness of each action will be evaluated to facilitate an understanding of the obtained results.

This phase took place thanks to the compilation of a generic format for all PPs, where each PP has chosen its quantitative indicators. The PPs presented lists of indicators, designed according to their specific socioeconomic context.

2.1 Database of indicators to assess the CC impacts

1. Surface of green areas: *It is the amount of new green areas provided by the action*
2. Surface of built-up areas: *It is the amount of new built-up areas made by the action.*
3. Land surface temperature mean value.
4. NDVI: *Normalized Difference Vegetation Index*
5. NDBI; *Normal Difference Built-up Index*
6. Surface of areas no longer vulnerable to “sea level rise” by scenario involving 1 m sea-level rise
7. Impermeable surface: *It is the amount of new built-up areas made by the action*
8. Floristic areas: *It is the amount of Floristic areas provide by the action*
9. Public beaches surface: *It is the number of Public beaches provide by the action*
10. Dunes surface: *It is the number of dunes provide by the action*
11. Coastal protection infrastructures: *It is the amount of GI provide by the action*
12. Water consumption: *It is the amount of fresh water saved by the action,*

2.2 Chosen set of indicators and related impact

IRENA (Vrsar, Rovinj, Poreč)

Urban heat island, variables considered:

- Surface of green areas: It is the amount of new green areas provided by the action.
- Surface of built-up areas: It is the amount of new built-up areas made by the action.
- Land surface temperature mean value.

Urban flooding, variables considered:

- NDVI: Normalized Difference Vegetation Index
- NDBI; Normal Difference Built-up Index

Sea level rise, variables considered:

- Surface of areas no longer vulnerable to “sea level rise” by scenario involving 1 m sea-level rise

Municipality of Dubrovnik

Urban heat island, variables considered:

- Surface of green areas: It is the amount of new green areas provided by the action.
- Surface of built-up areas: It is the amount of new built-up areas made by the action.
- Land surface temperature mean value.

Urban flooding, variables considered:

- NDVI: Normalized Difference Vegetation Index
- NDBI; Normal Difference Built-up Index

Sea level rise, variables considered:

- Surface of areas no longer vulnerable to “sea level rise” by scenario involving 1 m sea-level rise

Dune Costiere Park

Coastal erosion, variables considered:

- Surface of green areas: It is the amount of new green areas provided by the action.
- Surface of built-up areas: It is the amount of new built-up areas made by the action.

Municipality of Pesaro

Increased energy demand for cooling, variables considered:

- Surface of green areas: It is the amount of new green areas provided by the action.
- Impermeable surface: It is the amount of new built-up areas made by the action
- Land surface temperature mean value

Increased coastal erosion in natural areas, variables considered:

- Floristic areas: It is the amount of Floristic areas provide by the action
- Public beaches surface: It is the number of Public beaches provide by the action
- Dunes surface: It is the number of dunes provide by the action
- Coastal protection infrastructures: It is the amount of GI provide by the action

Water competition, variables considered:

- Water consumption: It is the amount of fresh water saved by the action, based on MarcheMultiservizi data.

Municipality of Misano

Increased energy demand for cooling, variables considered:

- Surface of green areas: It is the amount of new green areas provided by the action.
- Impermeable surface: It is the amount of new built-up areas made by the action
- Land surface temperature mean value

3. Monitoring system

The monitoring of climate adaptation plans carried out in activity 3.3, is an important step to raise awareness and improve knowledge about climate change impacts in local context. The kind of information obtained through these analyzes is a fundamental component to control and monitoring climate adaptation plans, as well as to support local public administrations to make appropriate decisions related to climate measures and to develop coherent actions.

Sector	Impacts
Agriculture	Variation in crop yield
	Variation in livestock production
	Increased irrigation demand
Hydrology and water resources	Increase of drought
	Increase of flooding
	Increased competition for water
	Increase of urban flooding
Coasts	Increased erosion
	Coastal flooding
	Damage to costal human infrastructures
	Damage to costal natural environments
Energy	Impacts on energy infrastructures (energy plants, etc)
	Increased energy demand for cooling
Socio-economic	Increased Urban Heat Island effect
	Impacts on weakest group of people
	Impacts on commercial activities
	Impacts on public services
	Impacts on industrial activities
	Impacts on transportation network
	Impacts on tourism sector
Ecosystems and environment	Loss of species
	Loss of habitat
	Increased forest fires
	Increase of invasive species and parasites

Table 1: First list of climate change impacts from which the PPs are asked to choose

The methodology was undertaken to develop a specific "monitoring system" based on the algorithms used in the first part of analyzes about the selected impacts, from a first list (Table 1). This is particularly useful as it allows a rational comparison between the initial and project status for each pilot area. Therefore, for each area there are specific indicators that refer to the initial set of selected impacts, to evaluate the ability to adapt to the current urban territory.

3.1 Definition of data & process factor

To develop an appropriate analysis for each case study, as mentioned above it was decided, in agreement with all partners to focus on four main climate change impacts (and related hazards) identified as the most relevant for the pilot areas. The monitoring system is generally necessary as it can assess the degree of efficiency of a measure or action, in complying with some of the needs present in the context. In this case, it was decided to evaluate, how these initiatives can adapt to the local landscape concerning the set of impacts chosen by each case.

Furthermore, for each PP, the system was contextualized, firstly based on the available data and information, and subsequently based on the actions proposed and related impact within the Climate Adaptation Plan. To ensure certain ease in its use, the graphic interface has been the subject of numerous graphic and functional revisions. We have chosen to simplify the visualization of data and functions as much as possible in order to limit the possible discomfort deriving from matrices with more than 17 mathematical operators. The result of this operation consists of a summary table, containing starting and monitoring data, which allow a simple and immediate reading of the system, as shown in Table3.

Pilot area	Impacts
Misano Adriatico	Increased coastal erosion
	Increased energy demand for cooling
	Impacts on transportation network
	Impacts on tourism sector
Pesaro	Increased competition for water
	Increased coastal erosion in natural areas
	Increased energy demand for cooling
	Impacts on tourism sector
Parco delle Dune Costiere	Variation in crop yield

	Increase of drought
	Increased coastal erosion
	Loss of habitat
Dubrovnik & Rovinj, Vrsar, Poreč	Urban heat Island
	Urban flooding
	Sea level rise

Table 2 - Ultimate list of impacts for each pilot area

The algorithms are composed of mathematical factors, variables and constants that depending on the activities carried out can change the impact coefficient: evaluating the effects on the territory under study. Next, the list including the various factors considered in the elaboration of risks and impacts:

- *DSM (Digital Surface Model)*
- *DTM (Digital Terrain Model)*
- *Land Cover*
- *Land Use*
- *Protected Areas, ZPS, SIC*
- *Soil Type and geological map*
- *Administrative unit boundaries*
- *Population census data*
- *Buildings and infrastructures (street and railway, etc.)*
- *Slow mobility network*
- *Hydrology map*
- *Beach Nourishment Plan*
- *Cadastral data (commercial tourism activities, residential etc.)*
- *Cultural and Natural Heritage*
- *Tourist numbers data*
- *Tourist infrastructures and buildings*
- *Water consumption by sector (as detailed as possible)*
- *Energy Performance Certificate for Building*
- *Agriculture typology map*
- *Daily Precipitation and temperature data 1990 – 2017*

The system is therefore based on multiple factors, but the monitoring system proposed here is limited to considering only the factors that change about the action taken.

ACTION n° 2 TITLE: WAVES TO ENERGY						
RELATED IMPACT THAT THE ACTION MITIGATES				URBAN HEAT ISLAND		
ID Hexagon	LST_mean	Veg_mq	Buid_mq	Index UHI- starting point	Index UHI- monitoring point	
				#N/D	#N/D	
RELATED IMPACT THAT THE ACTION MITIGATES				URBAN FLOODING		
ID Hexagon	NDVI	NDBI		Index UHI- starting point	Index UHI- monitoring point	
0				#N/D	0	
RELATED IMPACT THAT THE ACTION MITIGATES				SEA LEVEL RISE		
ID Hexagon	Mq < 1m above sea-level			Index UHI- starting point	Index UHI- monitoring point	
0				#N/D	#N/D	

Table 3 - Ultimate selected graphic interface

ID Measure	NDA	NDB1	Index UHI starting point	Index UHI monitoring point	ID Measure	Mg > 1m above sea level	Index UHI starting point	Index UHI monitoring point
			#N/D	0			#N/D	#N/D
ID Measure	NDA	NDB1	Index UHI starting point	Index UHI monitoring point	ID Measure	Mg < 1m above sea level	Index UHI starting point	Index UHI monitoring point
			#N/D	0			#N/D	#N/D
ID Measure	NDA	NDB1	Index UHI starting point	Index UHI monitoring point	ID Measure	Mg < 1m above sea level	Index UHI starting point	Index UHI monitoring point
			#N/D	0			#N/D	#N/D

ACTION n° 8 TITLE: PROTECTION OF COASTAL INFRASTRUCTURE - VSAR

RELATED IMPACT THAT THE ACTION MITIGATES				URBAN FLOODING		RELATED IMPACT THAT THE ACTION MITIGATES				SEA LEVEL RISE		
ID Measure	NDA	NDB1	Index UHI starting point	Index UHI monitoring point	ID Measure	Mg > 1m above sea level	Index UHI starting point	Index UHI monitoring point	ID Measure	Mg < 1m above sea level	Index UHI starting point	Index UHI monitoring point
			#N/D	0			#N/D	#N/D			#N/D	#N/D
ID Measure	NDA	NDB1	Index UHI starting point	Index UHI monitoring point	ID Measure	Mg < 1m above sea level	Index UHI starting point	Index UHI monitoring point	ID Measure	Mg < 1m above sea level	Index UHI starting point	Index UHI monitoring point
			#N/D	0			#N/D	#N/D			#N/D	#N/D

ACTION n° 9 TITLE: PROTECTION OF COASTAL INFRASTRUCTURE - POREC'

RELATED IMPACT THAT THE ACTION MITIGATES				URBAN FLOODING		RELATED IMPACT THAT THE ACTION MITIGATES				SEA LEVEL RISE		
ID Measure	NDA	NDB1	Index UHI starting point	Index UHI monitoring point	ID Measure	Mg > 1m above sea level	Index UHI starting point	Index UHI monitoring point	ID Measure	Mg < 1m above sea level	Index UHI starting point	Index UHI monitoring point
2912	-0.15025	0.289	0.26648273	0.439578508	2915	7900	0.17764577	0.002152078	4460	55.64	0	0.0015153
ID Measure	NDA	NDB1	Index UHI starting point	Index UHI monitoring point	ID Measure	Mg < 1m above sea level	Index UHI starting point	Index UHI monitoring point	ID Measure	Mg < 1m above sea level	Index UHI starting point	Index UHI monitoring point
4460	-0.15025	0.289	0.50636003	0.439578508	4460	55.64	0	0.0015153				

Municipality of Dubrovnik

WP4 - MONITORING SYSTEM - PP DURA

ACTION n° 1 TITLE: PARKING LOTS ALTERATION -

RELATED IMPACT THAT THE ACTION MITIGATES				URBAN HEAT ISLAND		RELATED IMPACT THAT THE ACTION MITIGATES				URBAN FLOODING	
ID Measure	U1T_park	U1g_mg	U1kkt_mg1	Index UHI starting point	Index UHI monitoring point	ID Measure	NDA	NDB1	Index UHI starting point	Index UHI monitoring point	
329				0.22	-1.22	329			-0.56	0.00	

ACTION n° 2 TITLE: SEA WALL

RELATED IMPACT THAT THE ACTION MITIGATES				URBAN FLOODING		RELATED IMPACT THAT THE ACTION MITIGATES				SEA LEVEL RISE		
ID Measure	NDA	NDB1	Index UHI starting point	Index UHI monitoring point	ID Measure	Mg > 1m above sea level	Index UHI starting point	Index UHI monitoring point	ID Measure	Mg < 1m above sea level	Index UHI starting point	Index UHI monitoring point
401			0.20	0.00	401		0.20	0.00	401		0.20	0.00
ID Measure	NDA	NDB1	Index UHI starting point	Index UHI monitoring point	ID Measure	Mg < 1m above sea level	Index UHI starting point	Index UHI monitoring point	ID Measure	Mg < 1m above sea level	Index UHI starting point	Index UHI monitoring point
415			-6.57	0.00	415		0.15	0.15	415		0.24	0.24
ID Measure	NDA	NDB1	Index UHI starting point	Index UHI monitoring point	ID Measure	Mg > 1m above sea level	Index UHI starting point	Index UHI monitoring point	ID Measure	Mg > 1m above sea level	Index UHI starting point	Index UHI monitoring point
418			-0.22	0.00	418		0.24	0.24	418		0.24	0.24
ID Measure	NDA	NDB1	Index UHI starting point	Index UHI monitoring point	ID Measure	Mg < 1m above sea level	Index UHI starting point	Index UHI monitoring point	ID Measure	Mg < 1m above sea level	Index UHI starting point	Index UHI monitoring point
357			-1.15	0.00	357		0.20	0.20	357		0.20	0.20
ID Measure	NDA	NDB1	Index UHI starting point	Index UHI monitoring point	ID Measure	Mg > 1m above sea level	Index UHI starting point	Index UHI monitoring point	ID Measure	Mg > 1m above sea level	Index UHI starting point	Index UHI monitoring point
395			0.20	0.00	395		0.12	0.12	395		0.12	0.12
ID Measure	NDA	NDB1	Index UHI starting point	Index UHI monitoring point	ID Measure	Mg < 1m above sea level	Index UHI starting point	Index UHI monitoring point	ID Measure	Mg < 1m above sea level	Index UHI starting point	Index UHI monitoring point
354			0.20	0.00	354		0.01	0.01	354		0.01	0.01

ACTION n° 3 TITLE: GREEN ROOF

RELATED IMPACT THAT THE ACTION MITIGATES				URBAN HEAT ISLAND	
ID Measure	U1T_park	U1g_mg	U1kkt_mg1	Index UHI starting point	Index UHI monitoring point
57				0.22	-1.24

ACTION n° 4 TITLE: GREEN ROOF

RELATED IMPACT THAT THE ACTION MITIGATES				URBAN HEAT ISLAND	
ID Measure	LST_msm	Veg_mq	Build_mq	Index UHI: starting point	Index UHI: monitoring point
420				0,26	-1,13

ACTION n° 5 TITLE: NATURAL SHADING

RELATED IMPACT THAT THE ACTION MITIGATES				URBAN HEAT ISLAND	
ID Measure	LST_msm	Veg_mq	Build_mq	Index UHI: starting point	Index UHI: monitoring point
600				0,37	-1,12

ACTION n° 6 TITLE: NATURAL SHADING

RELATED IMPACT THAT THE ACTION MITIGATES				URBAN HEAT ISLAND	
ID Measure	LST_msm	Veg_mq	Build_mq	Index UHI: starting point	Index UHI: monitoring point
641				0,42	-1,08

ACTION n° 7 TITLE: NATURAL SHADING

RELATED IMPACT THAT THE ACTION MITIGATES				URBAN HEAT ISLAND	
ID Measure	LST_msm	Veg_mq	Build_mq	Index UHI: starting point	Index UHI: monitoring point
703				0,24	-1,24

ACTION n° 9 TITLE: GREEN PARKING LOT

RELATED IMPACT THAT THE ACTION MITIGATES				URBAN HEAT ISLAND	
ID Measure	LST_msm	Veg_mq	Build_mq	Index UHI: starting point	Index UHI: monitoring point
672				0,24	-0,97

RELATED IMPACT THAT THE ACTION MITIGATES			URBAN FLOODING	
ID Measure	NDVI	NDBI	Index UHI: starting point	Index UHI: monitoring point
672			-0,20	0,00

RELATED IMPACT THAT THE ACTION MITIGATES				URBAN HEAT ISLAND	
ID Measure	LST_msm	Veg_mq	Build_mq	Index UHI: starting point	Index UHI: monitoring point
704				0,40	-0,93

RELATED IMPACT THAT THE ACTION MITIGATES			URBAN FLOODING	
ID Measure	NDVI	NDBI	Index UHI: starting point	Index UHI: monitoring point
704			-0,15	0,00

ACTION n° 10 TITLE: GREEN PARKING SPACES WITH FILTER STRIP

RELATED IMPACT THAT THE ACTION MITIGATES				URBAN HEAT ISLAND	
ID Measure	LST_msm	Veg_mq	Build_mq	Index UHI: starting point	Index UHI: monitoring point
357				0,23	-1,24

RELATED IMPACT THAT THE ACTION MITIGATES			URBAN FLOODING	
ID Measure	NDVI	NDBI	Index UHI: starting point	Index UHI: monitoring point
357			-0,56	0,00

ACTION n° 11 TITLE: GREEN PARKING SPACES WITH FILTER STRIP

RELATED IMPACT THAT THE ACTION MITIGATES				URBAN HEAT ISLAND	
ID Measure	LST_msm	Veg_mq	Build_mq	Index UHI: starting point	Index UHI: monitoring point
704				0,40	-0,93

RELATED IMPACT THAT THE ACTION MITIGATES			URBAN FLOODING	
ID Measure	NDVI	NDBI	Index UHI: starting point	Index UHI: monitoring point
704			-0,15	0,00

ACTION n° 12 TITLE: THE MOBILE BARRIERS

RELATED IMPACT THAT THE ACTION MITIGATES			URBAN FLOODING	
ID Measure	NDVI	NDBI	Index UHI: starting point	Index UHI: monitoring point
354			-0,35	0,00

RELATED IMPACT THAT THE ACTION MITIGATES		SEA LEVEL RISE	
ID Measure	Mq > 1m above sea level	Index UHI: starting point	Index UHI: monitoring point
354		0,01	0,01

RELATED IMPACT THAT THE ACTION MITIGATES			URBAN FLOODING	
ID Measure	NDVI	NDBI	Index UHI: starting point	Index UHI: monitoring point
395			-0,11	0,00

RELATED IMPACT THAT THE ACTION MITIGATES		SEA LEVEL RISE	
ID Measure	Mq < 1m above sea level	Index UHI: starting point	Index UHI: monitoring point
395		0,14	0,14

Dune Costiere Park

WP4 - MONITORING implementation - Parco DUNE COSTIERE

ACTION n° 3 Restoration and Management of Biodiversity in the Park

RELATED IMPACT THAT THE ACTION MITIGATES		COASTAL EROSION	
ID Transept Area	Built_Up Areas	Index starting point	Index monitoring point
3		0,002269572	0,002269572
ID Transept Area	Built_Up Areas	Index starting point	Index monitoring point
4		0,005610411	0,005610411
ID Transept Area	Built_Up Areas	Index starting point	Index monitoring point
5		7,86105E-05	7,86105E-05
ID Transept Area	Built_Up Areas	Index starting point	Index monitoring point
6		0,000121697	0,000121697
ID Transept Area	Built_Up Areas	Index starting point	Index monitoring point
28		0,000591621	0,000591621
ID Transept Area	Built_Up Areas	Index starting point	Index monitoring point
29		0,024406696	0,024406696
ID Transept Area	Built_Up Areas	Index starting point	Index monitoring point
30		0,049198558	0,049198558
ID Transept Area	Built_Up Areas	Index starting point	Index monitoring point
31		0,12008743	0,12008743
ID Transept Area	Built_Up Areas	Index starting point	Index monitoring point
33		0,098693015	0,098693015
ID Transept Area	Built_Up Areas	Index starting point	Index monitoring point
34		0	0
ID Transept Area	Built_Up Areas	Index starting point	Index monitoring point
35		0	0
ID Transept Area	Built_Up Areas	Index starting point	Index monitoring point
36		0	0

ACTION n° 6 Restoration and Management of Biodiversity in the Park

RELATED IMPACT THAT THE ACTION MITIGATES		COASTAL EROSION	
ID Transept Area	Built_Up Areas	Index starting point	Index monitoring point
3		0,002269572	0,002269572
ID Transept Area	Built_Up Areas	Index starting point	Index monitoring point
4		0,005610411	0,005610411
ID Transept Area	Built_Up Areas	Index starting point	Index monitoring point
5		7,86105E-05	7,86105E-05
ID Transept Area	Built_Up Areas	Index starting point	Index monitoring point
6		0,000121697	0,000121697
ID Transept Area	Built_Up Areas	Index starting point	Index monitoring point
7	0,00	0,002955513	0,002955513
ID Transept Area	Built_Up Areas	Index starting point	Index monitoring point
8	0,00	0,024839988	0,024839988

ID Transept Area	Built_Up Areas
9	0,00
10	0,00
11	0,00
12	0,00
13	0,00
14	0,00
15	0,00
16	0,00
17	0,00
18	0,00
19	0,00
20	0,00
21	0,00
22	0,00
23	0,00
24	0,00
25	0,00
26	0,00
27	0,00
28	0,00
29	0,00

Index starting point	Index monitoring point
0,022408134	0,022406134
0,073511728	0,073511728
0,023145523	0,023145523
0,00901919	0,00901919
0,010547937	0,010547937
0,018973926	0,018973926
0,042275511	0,042275511
0,014224143	0,014224143
0,159972949	0,159972949
0,127561531	0,127561531
0,052349474	0,052349474
0,378585387	0,378585387
0,114081572	0,114081572
0,702938013	0,702938013
0,492650694	0,492650694
0,79858349	0,79858349
0,091811598	0,091811598
0,010095929	0,010095929
0,081364544	0,081364544
0,000591621	0,000591621
0,024406696	0,024406696

	30	0,00
ID Transept Area	Built_Up Areas	
	31	0,00
ID Transept Area	Built_Up Areas	
	33	0,00
ID Transept Area	Built_Up Areas	
	34	0,00
ID Transept Area	Built_Up Areas	
	35	0,00
ID Transept Area	Built_Up Areas	
	36	0,00

	0,049198558	0,049198558
Index starting point	Index monitoring point	
	0,120008743	0,120008743
Index starting point	Index monitoring point	
	0,098693015	0,098693015
Index starting point	Index monitoring point	
	0	0
Index starting point	Index monitoring point	
	0	0
Index starting point	Index monitoring point	
	0	0

ACTION n° 7 Recovery of coastal dunes

RELATED IMPACT THAT THE ACTION MITIGATES		COASTAL EROSION	
ID Transept Area	Built_Up Areas	Index starting point	
	6	56,00	Index monitoring point
			0,000121697
ID Transept Area	Built_Up Areas	Index starting point	
	7	1000,00	Index monitoring point
			0,002955513
ID Transept Area	Built_Up Areas	Index starting point	
	8	600,00	Index monitoring point
			0,024839988
ID Transept Area	Built_Up Areas	Index starting point	
	9	789,00	Index monitoring point
			0,022406134
ID Transept Area	Built_Up Areas	Index starting point	
	10	100,00	Index monitoring point
			0,073511728
ID Transept Area	Built_Up Areas	Index starting point	
	11	200,00	Index monitoring point
			0,023145523
ID Transept Area	Built_Up Areas	Index starting point	
	12	0,00	Index monitoring point
			0,00901919
ID Transept Area	Built_Up Areas	Index starting point	
	13	1111,00	Index monitoring point
			0,010547937
ID Transept Area	Built_Up Areas	Index starting point	
	17	2222,00	Index monitoring point
			0,159972949
ID Transept Area	Built_Up Areas	Index starting point	
	18	9090,00	Index monitoring point
			0,127561531
ID Transept Area	Built_Up Areas	Index starting point	
	19	2000,00	Index monitoring point
			0,052349474
ID Transept Area	Built_Up Areas	Index starting point	
	20	0,00	Index monitoring point
			0,378585387
ID Transept Area	Built_Up Areas	Index starting point	
	21	0,00	Index monitoring point
			0,114081572
ID Transept Area	Built_Up Areas	Index starting point	
	22	1111,00	Index monitoring point
			0,702938013

ID Transept Area	Built_Up Areas
23	2222,00
24	9090,00
25	2000,00
26	0,00
33	2000,00
36	0,00

Index starting point	Index monitoring point
0,492650694	0,576307224
0,79858349	1,327464977
0,091811598	0,103818445
0,010095929	0,010095929
0,098693015	0,098865746
0	0

Municipality of Misano adriatico

WP4 - MONITORING implementation - Municipality of Misano

ACTION n° 1 TITLE: Reduction of cooling demand in tourist accomadations

RELATED IMPACT THAT THE ACTION MITIGATES ENERGY DEMAND FOR COOLING

ID Census area	LST_mean	Vegetated surface	Impermeable surface
990050000008	35,00	700,00	2000,00

Index starting point	Index monitoring point
0,230872851	0,271178632

ACTION n° 2 TITLE: Improve outdoor microclimate of tourist accomadations

RELATED IMPACT THAT THE ACTION MITIGATES ENERGY DEMAND FOR COOLING

ID Census area	LST_mean	Vegetated surface	Impermeable surface
99050000001	29,00	1230,00	4560,00

Index starting point	Index monitoring point
0,86521834	0,809006997

ACTION n° 8 TITLE: Urban forest

RELATED IMPACT THAT THE ACTION MITIGATES ENERGY DEMAND FOR COOLING

ID Census area	LST_mean	Vegetated surface	Impermeable surface
990050000021	34,00	70,00	10000,00

Index starting point	Index monitoring point
0,69297881	0,32940249

Municipality of Pesaro

WP4 - MONITORING implementation - Municipality of Pesaro

ACTION n° 1 TITLE: Greening brownfield area/ Nature-based Solutions

RELATED IMPACT THAT THE ACTION MITIGATES	ENERGY DEMAND FOR COOLING
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ID Census area	LST_mean	Vegetated surface	Impermeable surface	Index starting point	Index monitoring point
410440000269				0,405004391	0,226233154

ACTION n° 2 TITLE: Recovery dune coastal environment of Area Sottomonte

RELATED IMPACT THAT THE ACTION MITIGATES	COASTAL EROSION IN NATURAL AREAS
--	----------------------------------

ID Transept Area	Floristic areas	Pblic beaches	Dunes	Coastal protection infrastructures	Index starting point	Index monitoring point
110					0,166250038	0,507392185

ID Transept Area	Floristic areas	Pblic beaches	Dunes	Coastal protection infrastructures	Index starting point	Index monitoring point
111					-0,003880991	0,125598912

ACTION n° 3 TITLE: Implementation of a New school NZEB, with Nbs

RELATED IMPACT THAT THE ACTION MITIGATES	ENERGY DEMAND FOR COOLING
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ID Census area	LST_mean	Vegetated surface	Impermeable surface	Index starting point	Index monitoring point
410440000500				0,405542934	0,214546007

ACTION n° 4 TITLE: Construction of a building complex

RELATED IMPACT THAT THE ACTION MITIGATES	ENERGY DEMAND FOR COOLING
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ID Census area	LST_mean	Vegetated surface	Impermeable surface	Index starting point	Index monitoring point
410440001205				0,280906336	0,046696442

ID Census area	LST_mean	Vegetated surface	Impermeable surface	Index starting point	Index monitoring point
410440001150				0,28907275	0,069333792

ACTION n° 5 TITLE: Recovering coastal's functions

RELATED IMPACT THAT THE ACTION MITIGATES	COASTAL EROSION IN NATURAL AREAS
--	----------------------------------

ID Transept Area	Floristic areas	Pblic beaches	Dunes	Coastal protection infrastructures	Index starting point	Index monitoring point
105					0,209175587	0,688739039

ID Transept Area	Floristic areas	Pblic beaches	Dunes	Coastal protection infrastructures
106				

Index starting point	Index monitoring point
-0,169614493	0,144129937

ID Transept Area	Floristic areas	Pblic beaches	Dunes	Coastal protection infrastructures
107				

Index starting point	Index monitoring point
-0,278459413	0,182712895

ID Transept Area	Floristic areas	Pblic beaches	Dunes	Coastal protection infrastructures
108				

Index starting point	Index monitoring point
-0,251052817	0,281334217

ID Transept Area	Floristic areas	Pblic beaches	Dunes	Coastal protection infrastructures
109				

Index starting point	Index monitoring point
0,061023748	0,389599366

ACTION n° 6 TITLE: Greening measures

RELATED IMPACT THAT THE ACTION MITIGATES	ENERGY DEMAND FOR COOLING
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ID Census area	LST_mean	Vegetated surface	Impermeable surface
410440000667			

Index starting point	Index monitoring point
0,342482305	0,135591748

3.3 Process limitations

The development of monitoring systems has revealed some limitations within the process of impacts analyzing. These limitations derive in part from the process of impact analysis, in which information bases of reconnaissance type were used. I.E. in the study of the "IMPACT ON TRANSPORTATION NETWORK" or the "INCREASED COMPETITION FOR WATER", the vulnerability classes identified in the provincial area, by the PAI, were used. In these cases, the Monitoring system is referred to the competence of the higher-level body, which produces periodically the data, to monitor the effects and changes on the territory of its competence.

Finally, a further limitation of the procedure used is the reduced number of environmental variables taken into consideration by the algorithm. This means that what emerges from the analysis is the result of a modest estimate of the factors that suggest some environmental dynamics. It is therefore advisable to implement this aspect by carrying out further investigations and studies aimed at corroborating what emerged.

Another emerged limitation in the fill-in of the monitoring system is represented by specific actions that, although inspired by best practices with verified effectiveness, do not change the variables of the chosen algorithm. In these cases, the system seems to be ineffective, therefore it is also necessary to integrate the system with further context studies.

Selected impacts	Monitoring system
	yes
Increased energy demand for cooling,	yes
Impacts on transportation network	<i>no, depend by region competence</i>
Impacts on tourism sector	<i>no, depend by region competence</i>
Increased competition for water	<i>no, depend by region competence</i>
Increased coastal erosion in natural areas	yes
Increased energy demand for cooling	yes
Impacts on tourism sector	<i>no, depend by region competence</i>
Variation in crop yield	<i>no, depend by region competence</i>
Increase of drought	<i>no, depend by region competence</i>
Increased coastal erosion	yes
Loss of habitat	<i>no, depend by region competence</i>
Urban heat Island	yes
Urban flooding	yes

Sea level rise	yes
Urban heat Island	yes
Urban flooding	yes
Sea level rise	yes

Table 4 - List of impacts and relative opportunities to draft a monitoring system

Pilot area	Impacts
Misano Adriatico	Increased coastal erosion
	Increased energy demand for cooling
	Impacts on transportation network
	Impacts on tourism sector
Pesaro	Increased competition for water
	Increased coastal erosion in natural areas
	Increased energy demand for cooling
	Impacts on tourism sector
Parco delle Dune Costiere	Variation in crop yield
	Increase of drought
	Increased coastal erosion
	Loss of habitat
Dubrovnik	Urban heat Island
	Urban flooding
	Sea level rise
Rovinj, Vrsar, Poreč	Urban heat Island
	Urban flooding
	Sea level rise

Table 5 - Ultimate list of elaborated impacts for each pilot area

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List of ANNEXES

- Monitoring system LP
- Monitoring system PP1
- Monitoring system PP3
- Monitoring system PP4
- Monitoring system PP5