Best practice

LIFE SEC ADAPT PROJECT

risk and vulnerability assessment in Istria

Prepared by:

IRENA – PP1

Title of the Case study	VULNERABILITY AND RISK ASSESSMENT ANALYSIS PROCJENA RANJIVOSTI I RIZIKA
General data	
Promoter	IDA – Istrian Development Agency in the scope of LIFE SEC ADAPT PROJECT - *Upgrading Sustainable Energy Communities in Mayor Adapt initiative by planning Climate Change Adaptation strategies* (LIFE 2014 – 2020 – Climate Change Adaptation programme) Source: http://www.lifesecadapt.eu/fileadmin/user_upload/ALLEGATI_LIFESECADAPT/EXCHANGE/C2_Risk_and_Vulnerability_Assessment_analysis/REPORTS/CROATIA_REGIONAL_LEVEL/Report_Risk_and_Vulnerability_Region_of_Istria.pdf, p.1
Timeframe	September 2015 - June 2019 Source: https://ida.hr/hr/bn/eu-projekti/aktualni-eu-projekti/detail/2/life-sec-adapt-upgrading-sustainable-energy-communities-mayor-adapt-initiative-planning-climate-change-adaptation-strategies/
Target area and scale	Municipality of Istrian region territory, 2.820 m^2, population 208.055 (data from 2011.) Source: http://www.lifesecadapt.eu/fileadmin/user_upload/ALLEGATI_LIFESECADAPT/EXCHANGE/C2_Risk_and_Vulnerability_Assessment_analysis/REPORTS/CROATIA_REGIONAL_LEVEL/Report_Risk_and_Vulnerability_Region_of_Istria.pdf, p.4 https://www.istra-istria.hr/index.php?id=263 https://www.istra-istria.hr/index.php?id=14
Brief description	The Case study, named *Vulnerability and Risk Assessment analysis* is focused on providing a detailed assessment of climate change risks and vulnerability for the Municipality of Istrian region territory. Sectors of particular interest within the Istrian region, reviewed and assessed in the document are: health, tourism, water supply and water quality, ecosystems and biodiversity, and spatial planning and coastal area management. Evaluating the impacts that climate change will have on local selected economic sectors, the best actions to limit or reduce risks and related economic and social costs are identified, thus better orienting the future climate change adaptation strategies. The first step regards the vulnerability assessment starting from the evaluation of the exposure, sensitivity, and adaptive capacity to the impact of climate change in a long - term period of each specific key sector identified. This assessment determines the level of vulnerability, after which the results are matched with the risk assessment analysis that, through the evaluation of the consequence and of the probability of a climate change impact on the same sectors previously analyzed, allows to estimate the level of risk of the system. The final matrix, matching vulnerability and risk results of each urban system analyzed, provides a clear overview of the most important sectors of interventions on which the urban local adaptation strategy should focus in order to significantly reduce the climate change impact on the municipal urban system. Source: http://www.lifesecadapt.eu/fileadmin/user_upload/ALLEGATI_LIFESECADAPT/EXCHANGE/C2_Risk_and_Vulnerability_Assessment_analysis/REPORTS/CROATIA_REGIONAL_LEVEL/Report_Risk_and_Vulnerability_Region_of_Istria.pdf, p.4

Contribution of the Case study to the Joint_SECAP guidelines for Vulnerability and Risk assessment	
Modules of the guidelines relevant to the case study	*Please select one or more Modules that you think the Case study gives a significant contribution to (i.e. through methodologies, methods, tools…). Refer to the Joint_SECAP Guidelines for further information on Modules:* √ M1 PREPARING THE RISK ASSESSMENT (describes the context of the assessment - processes, knowledge, institutions, resources and external factors –, identifies its objectives, expected outcomes and scope, and defines tasks, responsibilities and time planning) √ M2 DEVELOPING IMPACT CHAINS (identifies and clusters impacts and risks, identifies hazard and intermediate impacts, vulnerability and exposure of the system) √ M3 IDENTIFYING AND SELECTING INDICATORS (identifies and select indicators for hazards, vulnerability and exposure) √ M4 DATA ACQUISITION AND MANAGEMENT (regards the collection, quality check, storage and management of data) √ M5 NORMALIZATION OF INDICATOR DATA (provides normalized data for each indicator in a standardized value) √ M6 WEIGHTING AND AGGREGATING OF INDICATORS (evaluates the influence of the indicators on the respective risk component, assigns different weights, aggregates individual indicators into composite indicators of the risk components hazard, vulnerability and exposure) √ M7 AGGREGATING RISK COMPONENTS TO RISK (aggregates the risk components into a composite risk indicator) M8 PRESENTING THE OUTCOMES OF YOUR RISK ASSESSMENT (describes how to elaborate the risk assessment report, taking into account both the objective and the target audience of the assessment)
Description of the contribution of the Case study to the Joint_SECAP guidelines	*Please provide a detailed description of how the Case study contributes to the modules selected above, i.e. by explaining the methodological approach adopted, the methods and tools used, etc. The lines corresponding to the modules that are NOT been selected above shall be left blank:* **M1:** Adopting the European Union's Climate Change Adaptation Strategy, in April 2013, the European Commission established a framework and mechanisms to raise EU countries' preparedness for present and future climate impacts, raising them to a whole new level. The EU's Climate Change Adaptation Strategy aims to make Europe more resilient to climate change and sets out its three key objectives, which are complementary to Member States' activities: • Promoting action towards the Member State: The Commission encourages all Member States to adopt comprehensive adaptation strategies, which will provide assistance in providing guidance in the implementation of the process, as well as financial resources that will enable the establishment and capacity building of adaptation and the implementation of concrete measures. The European Commission will encourage the adaptation of Cities by voluntarily joining the same initiatives of the

European Union, which will be based on the initiative of the Mayor Agreement

• Promoting better information in the decision-making process by addressing adaptation gaps and further developing the Climate Adaptation Platform (ADAPT) as a starting point for all information on climate change adaptation processes across Europe.

• Promoting adaptation processes in key, vulnerable, sectors through agriculture, fisheries and cohesion policy, ensuring that European infrastructure is more resilient and encouraging the use of insurance mechanisms against natural or human-caused disasters. Lack of knowledge, the European Union addresses itself through research and through the European Climate Change Adaptation Platform.

Launched in March 2012, this platform provides several useful tools to support adaptation policy and decision making. Some of the platform's tools are: an adaptation planning tool, a database of completed projects and studies completed, and information on adaptation activities carried out at all levels, from EU, national and regional, to the local level. The CLIMATE - ADAPT platform has been established to provide access to databases and exchange of information regarding expected climate change across Europe, as well as strategies and possible ways to adapt to potential changes (http: //climate-adapt.eea.europa.eu/) . There are different scenarios for assessing the impact of climate change, so that measures to slow down unwanted processes are taken into account, as well as ways to adapt to such changes. Pursuant to the decision of the Croatian Parliament to promulgate the Law on Ratification of the United Nations Framework Convention on Climate Change (UNFCC) of 23 January 1996, Croatia assumed the obligations of the United Nations Framework Convention on Climate Change and produced the First National Report of the Republic of Croatia to the UNFCCC (Ministry of Environment and Physical Planning, 2001).

Currently, the sixth national report of the Republic of Croatia under the UNFCCC (Croatian Hydro-Meteorological Institute, 2013) is in force, while in mid-May 2016, the Ministry of the Environment and Nature began implementing a project entitled ''Capacity building of the Ministry of Environment and Nature for climate change adaptation and the preparation of the draft Climate Change Adaptation Strategy '', which is currently in its final stages.

The purpose of this document is to identify sectors that are vulnerable to climate change, to conduct a sensitivity analysis of sectors of particular importance to the Istrian region, and to draw conclusions about the potential risks of adverse effects of climate change in the observed area.

The objective of activity C.2 is to provide the cities and municipalities involved in the implementation of the project with a detailed analysis of the vulnerability and risk assessment of climate change impacts in their respective cities and municipalities. Through assessing the impact that climate change will have on locally selected sectors of particular importance, the best measures will be identified to limit or, at the same time, reduce the risks and associated economic and social costs, and thereby provide good a landmark to guide their future climate change adaptation strategies. In accordance with the methodology developed by the Istrian Development Agency (IDA), cities and municipalities will carry out vulnerability and risk assessments in two consecutive steps. The first step involves assessing vulnerability, starting with an assessment of exposure, sensitivity and ability to adapt to the impact of climate change over the long term on a sector-specific basis for each city or municipality. This assessment enables cities and municipalities to determine the level of vulnerability (low, medium or high) for each sector of particular importance.

The results are then collated with a risk assessment analysis which, through an assessment of the

	consequences and likelihood of climate change impact on the sectors previously analyzed, enables the assessment of system risks (high, medium, low). The final matrix, which responds to the vulnerability and risk outcomes of each urban system analyzed, provides a clear overview of the most important areas of intervention to which an urban local adaptation strategy should focus in order to significantly reduce the impact of climate change on the urban / municipal urban system. Source:http://www.lifesecadapt.eu/fileadmin/user_upload/ALLEGATI_LIFESECADAPT/EXCHANGE/C2_Risk_and_Vulnerability_Assessment_analysis/REPORTS/CROATIA_REGIONAL_LEVEL/Report_Risk_and_Vulnerability_Region_of_Istria.pdf, p.7-8,10-11 <u>Sectors selected for climate change effects analysis</u>: • Tourism • Environmental protection and biodiversity • Water supply and water quality • Health Source:http://www.lifesecadapt.eu/fileadmin/user_upload/ALLEGATI_LIFESECADAPT/EXCHANGE/C2_Risk_and_Vulnerability_Assessment_analysis/REPORTS/CROATIA_REGIONAL_LEVEL/Report_Risk_and_Vulnerability_Region_of_Istria.pdf, p.19 <u>Expected effects of climate changes by sectors (long term variations)</u> **Health sector:** - Medium temperature heat wave: Mortality, primarily due to cardiovascular disease and increased hospitalization Spreading of transmissible and infectious diseases Changes in allergy patterns Heat stress Pulmonary diseases Number of alergic persons - Drought: Air quality deteoration Trace elements accumulation - Strong precipitation: Injuries and death Disease spreading due to water contamination Increased mortality/injuries due to car accidents - Thunderstorms (sea level): Injuries and death **Water supply and water quality sector**: -Medium temperature heat wave: Increased water demand

		Problems with drinking water quality maintenance – low subterranean water sources and slower water renewal
		Increased maintenance cost
		Increased evaporation/outflow of water
		Spreading of algae and bacteria
	- Drought:	Water shortage - Problems with water quality maintenance
		Increased maintenance cost
		Low subterranean water sources and slower water renewal
		Water/soil salinisation
	- Strong precipitation:	Flood damage
		Increased maintenance cost
		Problems with drinking water quality maintenance
	- Thunderstorms (sea level):	Problems with drinking water quality maintenance
		Salt water penetration into subterranean water storage and surface waters
	Tourism sector:	
	-Medium temperature heat wave:	Changes in tourist numbers
		Changes in landscape
		Cost increases (for example for cooling)
	- Drought:	Changes in tourist numbers
		Changes in vistas
		Cost increases (for example for water supply)
	- Strong precipitation:	Damage on tourist infrastructures – increased repair costs and maintenance costs
		Flood damage
		Landslide damage
	- Thunderstorms (sea level):	Damage on tourist infrastructures – increased repair costs and maintenance costs
		Degradation of areas near the sea (beaches…)

	Agriculture and forestry sector:	
	-Medium temperature heat wave:	Changes in cultivation cycles
		Increase/decrease of certain species
	- Drought:	Damage or degradation of yield quality
		Desertification
		Salt water penetration due to intensive irrigation
		Decrease of area of useful agricultural land
		Changes in cultivation cycles
	- Strong precipitation:	Land erosion
		Flood damage
		Landslide damage
		Damage or degradation of yield quality
		Decrease of area of useful agricultural land
	- Thunderstorms (sea level):	Damage or degradation of yield quality
		Decrease of area of useful agricultural land
		Salt water penetration into subterranean water storage and surface waters
	Parks and protected areas / biodiversity / land ecosystems:	
	-Medium temperature heat wave:	Change in demands and patterns of behaviour
		Increased maintenance costs due to extensive use of water
		New invasive species in flora and fauna
		Change and loss of species and habitats
	- Drought:	Change and loss of species and habitats
		New invasive species in flora and fauna
		Increased maintenance costs due to extensive use of water
		Higher probability of fire
	- Strong precipitation:	Damage on infrastructures and vegetation
		Change and loss of species and habitats
	- Thunderstorms (sea level):	Damage on infrastructures and vegetation

		Change and loss of species and habitats
	Sea and coastline:	
	-Medium temperature heat wave:	Appearance of invasive allochthonous species
	- Drought:	-
	- Strong precipitation:	Decrease of bathing water quality
		Damage on coastal infrastructure
		Damage due to landslide
	- Thunderstorms (sea level):	Damage on coastal infrastructure
		Coast erosion
		Salt water penetration
		Changes in surface waters
		Damage on water drainage systems

Source:http://www.lifesecadapt.eu/fileadmin/user_upload/ALLEGATI_LIFESECADAPT/EXCHANGE/C2_Risk_and_Vulnerability_Assessment_analysis/REPORTS/CROATIA_REGIONAL_LEVEL/Report_Risk_and_Vulnerability_Region_of_Istria.pdf, p.20-23

M2:

Vulnerability: The characteristics and circumstances of a community, system, or property that make them vulnerable to the harmful effects of (some) danger. There are many aspects of vulnerability that arise from various physical, social, economic and environmental factors. Examples could include poor design and construction of facilities, inadequate property protection, lack of public information and awareness, limited official recognition of risk and preparedness measures, and disregard for wise environmental management. Vulnerability varies significantly within the community and over time. This definition recognizes vulnerability as a characteristic of an element of diverse interests (community, system or property) that is independent of its exposure. However, in common usage, the word is often used in a broad sense, including exposure to natural elements (which may or may not be caused by climate change or variation).

The above definition can be considered comprehensive because it does not specify what "vulnerability" means within a specific thematic area, such as the effects of climate change, for example. Therefore, when talking about the effects of climate change, it is a good idea to mention the definition of "vulnerability" proposed by the International Panel on Climate Change (IPCC), which reads: Vulnerability to climate change is the degree of sensitivity of geophysical , biological and socio-economic systems, as well as their diminished capacity to cope with the adverse effects of climate change. The term "vulnerability" may thus refer to the vulnerable systems themselves, for example in low lying islands or coastal cities; the effects on these systems, for example in the event of flooding of coastal cities and agricultural areas or forced migration caused by these events; or the mechanisms themselves that cause these effects, such as, for example, the disintegration of the ice layer in western Antarctica. The International Panel on Climate Change (IPCC) (IPCC, Climate Change 2001: Scientific Basis. Third Assessment Report of the Intergovernmental Panel on Climate Change,

2001) defines vulnerability as “a function of the shape, size and degree of climate variation to which a system is exposed, its sensitivity to climate change and its adaptability '. The European Union has taken on this definition, adding that vulnerability is "the degree of sensitivity of a system to the adverse effects of climate change, including climate variability and extreme weather events, and its inability to cope with these phenomena" (European Commission, 2013).

Vulnerability can be expressed in the form of a function:

Vulnerability = f (Exposure, Sensitivity, Adaptability) a is calculated by the formula: V = E + S - AC where:

• E = Exposure - the extent to which the system is exposed to significant climate change (IPCC 2001).

• S = sensitivity - the extent to which the system is adversely or favorably affected by climate variability or change (IPCC 2014).

• AC = adaptive capacity - the ability of systems, institutions, humans and other organisms to adapt to potential damage, seize opportunities, or respond to consequences (IPCC 2001).

Exposure + Sensitivity = Potential impact

The sum of exposure and sensitivity determines the potential impact of climate change. Exposure, sensitivity, and adaptability values are given in integers and take discrete values from 1 to 5, with 1 being the lowest level of exposure, sensitivity, and ability to adjust, and 5 being the highest degree of the same functions. The same formula is used in all vulnerability calculations.

Source:http://www.lifesecadapt.eu/fileadmin/user_upload/ALLEGATI_LIFESECADAPT/EXCHANGE/C2_Risk_and_Vulnerability_Assessment_analysis/REPORTS/CROATIA_REGIONAL_LEVEL/Report_Risk_and_Vulnerability_Region_of_Istria.pdf p.26

The intensity of an event describes the severity and magnitude of an individual hazard, whether expressed in a qualitative or quantitative form. Intensity itself is defined as a pre-established minimum threshold (minimum threshold) that determines whether an event, whether extreme or not, can be considered a hazard. Identifying and determining a minimum level of intensity values is essential for identifying and identifying extreme events, hazards that have occurred in the past, and for assessing the likelihood of their recurrence in the future. The likelihood of extreme events, risks (hazards) can be determined in several ways, but all must be based on the use of real, historical data. For the purpose of analyzing the probability of occurrence of extreme events, hazard (hazard), this document will look at historical climatic data for the past 30 years, while a numerical estimate of the probability of occurrence of an individual extreme event, hazard (hazard) will be assigned in the future based on the frequency of occurrence of the observed event. of an extreme event in the observed past period.

Frequency of occurrence of an individual extreme	Assessment of the probability of occurrence

events (hazard) (over the past 10-year period):	of an individual extreme event (hazard)
More than 25 times	5 (almost certain)
Between 10 and 24 times	4
Between 5 and 9 times	3
Between 1 and 4 times	2
Never	1 (almost impossible)

Source:http://www.lifesecadapt.eu/fileadmin/user_upload/ALLEGATI_LIFESECADAPT/EXCHANGE/C2_Risk_and_Vulnerability_Assessment_analysis/REPORTS/CROATIA_REGIONAL_LEVEL/Report_Risk_and_Vulnerability_Region_of_Istria.pdf, p.28

M3:

The matrix attributing the colors to the numerical values of the indicators, and following the analysis of the resulting numerical values of exposure, vulnerability, ability to adapt, and later risk, is presented below.

Class	Value	Status	Transformed indicatior value '0 – 1'	Color
1	0,0 – 0,2	Optimal	0,1	
2	0,2 – 0,4	Positive	0,3	
3	0,4 – 0,6	Neutral	0,5	
4	0,6 – 0,8	Negative	0,7	
5	0,8 – 1,0	Critical	0,9	

The process of determining exposure, sensitivity and later vulnerability for each sector will be performed in accordance with the logical framework above, the transformation tables above, and graphically presented in the above table with the visual characteristics indicated, and based on, at the time of making this document, available numerical data and indicators. This document was created in accordance with the methodology for developing vulnerability and risk assessments within the Life SEC Adapt project.

Source:http://www.lifesecadapt.eu/fileadmin/user_upload/ALLEGATI_LIFESECADAPT/EXCHANGE/C2_Risk_and_Vulnerability_Assessment_analysis/REPORTS/CROATIA_REGIONAL_LEVEL/Report_Risk_and_Vulnerability_Region_of_Istria.pdf p.27

Health sector - Exposure variable (EX) contains the following indicators:

EX01 – Mean daily air temperature (TM)

EX02 – Number of tropical nights (TR20)

	EX03 - Number of hot days (HD) EX04 – Duration of warm periods (WSDI) Source:http://www.lifesecadapt.eu/fileadmin/user_upload/ALLEGATI_LIFESECADAPT/EXCHANGE/C2_Risk_and_Vulnerability_Assessment_analysis/REPORTS/CROATIA_REGIONAL_LEVEL/Report_Risk_and_Vulnerability_Region_of_Istria.pdf, p.32 **Tourism sector** - Exposure variable (EX) contains the following indicators: EX01 – Mean maximum daily air temperature (tasmax) EX02 – Number of hot days (HD) EX03 – Number of warm days (SU25) EX04 – Total average rainfall Source:http://www.lifesecadapt.eu/fileadmin/user_upload/ALLEGATI_LIFESECADAPT/EXCHANGE/C2_Risk_and_Vulnerability_Assessment_analysis/REPORTS/CROATIA_REGIONAL_LEVEL/Report_Risk_and_Vulnerability_Region_of_Istria.pdf, p.49 **Water supply and water quality sector** - Exposure variable (EX) contains the following indicators: EX01 – Mean daily air temperature (TM) EX02 – Total average rainfall EX03 – Duration of droughts (CDD) Source:http://www.lifesecadapt.eu/fileadmin/user_upload/ALLEGATI_LIFESECADAPT/EXCHANGE/C2_Risk_and_Vulnerability_Assessment_analysis/REPORTS/CROATIA_REGIONAL_LEVEL/Report_Risk_and_Vulnerability_Region_of_Istria.pdf , p.70 **M4:** Regarding data acquisition and management, the data collection is listed below: **Health sector**: Health Sector Exposure Analysis on Climate Change Impact - Following on from the individual findings of the six cities analyzed in the Current City Climate Assessment Report, variability and changes in climate trends can be observed that can be considered as indicative indicators of an individual's exposure to climate change . On the basis of all the conducted surveys, the average value was considered as relevant for the region of Istria. SENSITIVITY INDICATOR SE01 - Population - population figures refer to official data according to the 2011 census and are taken from the official website of the Central Bureau of Statistics (www.dzs.hr). SENSITIVITY INDICATOR SE02 - Population density - Population density data were obtained by dividing the population (data downloaded from the official website of the Central Bureau of Statistics - www.dzs.hr) by the total area of the settlement (data taken from the Spatial Plan of the County of Istria).

	SENSITIVITY INDICATOR SE03 - Population 65+ - Population over 65 (breakdown by settlements), refer to official data according to the 2011 census and are downloaded from the official website of the Central Bureau of Statistics (www.dzs.hr) SENSITIVITY INDICATOR SE04 - Population under 5 years - data on the population under 5 (division by settlements), refer to official data according to the census conducted in 2011 and are taken from the official website of the Central Bureau of Statistics (www.dzs.hr). SENSITIVITY DIRECTOR SE05 - Settlement of the settlement For the indicated indicator, the data on settlement construction were used in such a way that the average of six cities for which a single settlement analysis was performed was taken. SENSITIVITY INDICATOR SE06 - Availability of health services -. Data on the distance from the JLS to the Pula General Hospital were recorded in kilometers and minutes, and these were obtained using the application of the Croatian Auto Club (www.hak.hr). ADJUSTMENT ABILITY INDICATOR AC01 - Degree of education of the population - the birth value of the degree of education of the population was obtained by looking at the number of residents over 15 years of age who have completed high school and higher (division by settlements). Data refer to official data according to the census conducted in 2011 and are taken from the official website of the Central Bureau of Statistics (www.dzs.hr) . ADAPTATION ABILITY INDICATOR AC02 - Per capita GDP - at the time of drafting this document, the most recent publicly available and available data related to gross domestic product for the Republic of Croatia at the county level is 2015. Data refer to official data and are taken from the official release of the Central Bureau of Statistics (www.dzs.hr). Source:http://www.lifesecadapt.eu/fileadmin/user_upload/ALLEGATI_LIFESECADAPT/EXCHANGE/C2_Risk_and_Vulnerability_Assessment_analysis/REPORTS/CROATIA_REGIONAL_LEVEL/Report_Risk_and_Vulnerability_Region_of_Istria.pdf, p.32-37, 39, 41 **Tourism sector**: Following the findings of the Report on the Assessment of the Current State of Climate Indicators for the City of Poreč - Parenzo / City of Pula and the City of Rovinj, variability and changes in climate trends in the Western Istrian region can be observed, which can be considered as indicative indicators of the Istrian region's exposure to climate change. The data are relevant to all the areas located on the coast of the Istrian region - for exposure indicators SENSITIVITY INDICATOR SE01 - Share of Tourism Revenues- According to the data from the Master Plan of Tourism of the County of Istria 2015 - 2025, clusters in the area of Istria have been defined, and the overview of tourism revenues in the cluster area is given in the table below. SENSITIVITY INDICATOR SE02 - Number of arrivals, number of nights spent In accordance with the data of the Poreč Tourist Board, the table below provides information on the number of arrivals and the number of nights spent in the County of Istria from 1998 to 2016.

	Through daily rainfall analysis for a period of 30 years (from 1986 to 2015), and on the basis of data from the State Hydrometeorological Institute recorded at the climatic station Poreč / Rovinj / Pula, a significant increase in the number of days with precipitation on an annual level was detected, as well as the rising trend. Source:http://www.lifesecadapt.eu/fileadmin/user_upload/ALLEGATI_LIFESECADAPT/EXCHANGE/C2_Risk_and_Vulnerability_Assessment_analysis/REPORTS/CROATIA_REGIONAL_LEVEL/Report_Risk_and_Vulnerability_Region_of_Istria.pdf, p.50, 56, 59 **Water supply and water quality sector**: EXPOSURE INDICATOR EX01 - Average daily air temperature (TM) - trend - In the regional report on the current state of climatic indicators in the Istria County, temperatures in Istria are shown by analyzing seasonal and annual values of mean (tsred), mean minimum (t-min)) and mean maximum (t-max) air temperatures and mean values of extreme temperature indices, according to data from the 1981-2010 reference period. for the meteorological stations Abrami (Buzet), Čepić (Labin) and Poreč, while for Pazin, Pula and Rovinj the values were taken from 1971 to 2000. The associated weather changes (trend) were examined according to a longer period: 1981-2015 for Abrami (Buzet), Cepic (Labin) and Porec, 1971-2000. and for Pazin, Pula and Rovinj the period 1961-2015 was taken. EXPOSURE INDICATOR EX02 - Total average rainfall - trend Rain conditions in Istria are shown by analysis of seasonal and annual rainfall amounts as well as mean values of extreme rainfall indices, according to data from the reference period 1981-2010 for Abrami (Buzet) meteorological stations, Čepić. (Labin) and Poreč, while values from 1971 to 2000 were taken for Pazin, Pula and Rovinj stations. The associated time changes (trend) were examined according to a longer period: 1981-2015 for Abrami (Buzet), Čepić (Labin) and Poreč, 1971 - 2000 and for Pazin, Pula and Rovinj the period 1961-2015 was taken. SENSITIVITY INDICATOR SE01 - Amount of water required for households - According to EUROSTAT data, the average water consumption in the household sector in the Republic of Croatia, in the period 2001-2013, ranged between 43 and 52 m3 / inhabitant. Data on water consumption in the household sector from 2006 to 2016 were obtained from the Istrian Water Supply Ltd., Buzet. SENSITIVITY INDICATOR SE03 - Quantity of water consumed in industry - Data on consumption of water consumed in industry in the Istria County in the period from 2006 to 2016 were obtained by the Istrian Water Supply Ltd., Buzet. ADJUSTMENT ABILITY INDICATOR AC01 - Degree of education - The numerical value of the level of education of the population was obtained by looking at the number of the population over 15 years of age who have completed high school and higher in the area of Istria. Data refer to official data according to the census conducted in 2011 and are taken from the official website of the Central Bureau of Statistics (www.dzs.hr). DANGER H01 - Number of dry periods of 7 consecutive days or more - Through analysis of daily rainfall for a period of 30 years (from 1986 to 2015), and based on data from the State

Hydrometeorological Institute, the average duration of dry periods (consecutive series of days) has been determined with a daily precipitation of Rd <1 mm) of 6.50 days for the observation period.

Source:http://www.lifesecadapt.eu/fileadmin/user_upload/ALLEGATI_LIFESECADAPT/EXCHANGE/C2_Risk_and_Vulnerability_Assessment_analysis/REPORTS/CROATIA_REGIONAL_LEVEL/Report_Risk_and_Vulnerability_Region_of_Istria.pdf, p.71-72, 75-77, 86

M5:

Exposure, sensitivity, and adaptability values are given in integers and take discrete values from 1 to 5, with 1 being the lowest level of exposure, sensitivity, and ability to adjust, and 5 being the highest degree of the same functions. The same formula is used in all vulnerability calculations for 1. Potential climate effect (ci), 2. Exposure factors, 3. Sensitivity factors and 4. Adjustment capacity.

In order to be able to carry out a computational process for determining the exposure for the sector concerned, it is necessary, after determining the impact that individual indicators have on exposure and assigning a class value, to equalize the parameter values in such a way that the numerical values for each indicator are transformed in the ''0 - 1'' range.

Class	Limit value	Description	Transformed indicatior value '0 – 1'
1	0,0 – 0,2	Optimal	0,1
2	0,2 – 0,4	Positive	0,3
3	0,4 – 0,6	Neutral	0,5
4	0,6 – 0,8	Negative	0,7
5	0,8 – 1,0	Critical	0,9

The matrix attributing the colors to the numerical values of the indicators, and following the analysis of the resulting numerical values of exposure, vulnerability, ability to adapt, and later risk, is presented in the table below.

Class	Value	Status	Transformed indicatior value '0 – 1'	Color
1	0,0 – 0,2	Optimal	0,1	
2	0,2 – 0,4	Positive	0,3	

3	0,4 – 0,6	Neutral	0,5		
4	0,6 – 0,8	Negative	0,7		
5	0,8 – 1,0	Critical	0,9		

Source:http://www.lifesecadapt.eu/fileadmin/user_upload/ALLEGATI_LIFESECADAPT/EXCHANGE/C2_Risk_and_Vulnerability_Assessment_analysis/REPORTS/CROATIA_REGIONAL_LEVEL/Report_Risk_and_Vulnerability_Region_of_Istria.pdf, p.26-27

M6:

Health sector:

Indicator EX01 - Mean daily temperature (TM); assigned weight 2

Indicator EX02 - Tropical nights (TR20); assigned weight 1

Indicator EX03 – Number of hot days (HD); assigned weight 2

Indicator EX04 – Trajanje toplih razdoblja (WSDI); assigned weight 1

Indicator SE01 - Population; assigned weight 1

Indicator SE02 – Population density; assigned weight 1

Indicator SE03 – Population older than 65 years; assigned weight 1

Indicator SE04 – Population younger than 5 years; assigned weight 1

Indicator SE05 - Construction development; assigned weight 1

Indicator SE06 - Health services accessibility; assigned weight 2

Indicator AC01 – Population education level; assigned weight 1

Indicator AC02 – Amount of GDP per capita; assigned weight 1

Indicator AC03 – Population educated through prevention programmes; assigned weight 1

Tourism sector:

Indicator EX01 - Mean maximum daily temperature (tmax); assigned weight 2

Indicator EX02 - Number of hot days (HD); assigned weight 1

Indicator EX03 - Warm days (SU25); assigned weight 1

Indicator EX04 – Total average rainfall; assigned weight 2

Indicator SE01 - Share of tourism revenue; assigned weight 2

Indicator SE02 – Number of arrivals, number of nights spent; assigned weight 1

Indicator AC01 – Amount of funds invested in events and development of new tourism programs; assigned weight 1

Water supply and water quality sector:

Indicator EX01 - Mean daily temperature (TM); assigned weight 1

Indicator EX02 – Total average rainfall; assigned weight 2

Indicator EX03 – Duration of droughts (CDD); assigned weight 2

Indicator SE01 - Amount of water needed for households; assigned weight 1

Indicator SE02 – Amount of water needed for irrigation; assigned weight 1

Indicator SE03 – Amount of water consumed in the industry; assigned weight 1

Indicator AC01 – Population education level; assigned weight 1

Indicator AC02 – Regulations restricting water consumption (for example, in summer - dry periods) or adopting provisions that promote water savings; assigned weight 1

Source:http://www.lifesecadapt.eu/fileadmin/user_upload/ALLEGATI_LIFESECADAPT/EXCHANGE/C2_Risk_and_Vulnerability_Assessment_analysis/REPORTS/CROATIA_REGIONAL_LEVEL/Report_Risk_and_Vulnerability_Region_of_Istria.pdf, p.32,33, 38, 42, 55, 57, 58, 74, 76, 77, 83

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Indicators for Health sector are aggregated in the following way:

POTENTIAL IMPACT (PI)	Increased mortality due to extreme weather conditions
EXPOSURE (EX)	EX01 - Average daily air temperature (tm) EX02 - Tropical Night (TR20) EX03 - Number of hot days (HD) EX04 - Warm Period Duration (WSDI)
SENSITIVITY (SE)	SE01 - Population SE02 - Population density SE03 - Population 65+ SE04 - Population under 5 years old

	SE05 - Settlement of settlements SE06 - Availability of Health Services
ADAPTATION ABILITY (AC)	AC01 - Degree of education of the population AC02 - GDP per capita AC03 - Number of residents educated through prevention programs
OBSERVED RISK (H)	H01 - Heat wave

Indicators for Tourism sector are aggregated in the following way:

POTENTIAL IMPACT (PI)	Changes in tourist flows
EXPOSURE (EX)	EX01 - Mean maximum daily air temperature (tasmax) EX02 - Number of hot days (HD) EX03 - Number of warm days (SU25) EX04 - Total average rainfall
SENSITIVITY (SE)	SE01 - Share of tourism revenue SE02 - Number of arrivals, number of nights spent
ADAPTATION ABILITY (AC)	AC01 - Marketing Investments AC02 - Investments in events and development of new tourism programs
OBSERVED RISK (H)	H01 - Daily precipitation of 3 consecutive days or more

Indicators for Water supply and water quality sector sector are aggregated in the following way:

POTENTIAL IMPACT (PI)	Reduction of available quantities (shortages) of drinking water due to decrease in well yield and decrease in flow rate
EXPOSURE (EX)	EX01 - Mean Daily Air Temperature (TM) EX02 - Total average rainfall EX03 - Drought Duration (CDD)

<table>
<tr><td></td><td>
<table>
<tr><td>SENSITIVITY (SE)</td><td>SE01 - Amount of water required for households

SE02 - Amount of water required for irrigation

SE03 - The amount of water consumed for industrial purposes</td></tr>
<tr><td>ADAPTATION ABILITY (AC)</td><td>AC01 - Degree of education of the population

AC02 - Regulations restricting water consumption (for example, in summer - drought periods) or adoption of provisions that promote water savings</td></tr>
<tr><td>OBSERVED RISK (H)</td><td>H01 - Number of dry periods of 7 days or more</td></tr>
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Source:http://www.lifesecadapt.eu/fileadmin/user_upload/ALLEGATI_LIFESECADAPT/EXCHANGE/C2_Risk_and_Vulnerability_Assessment_analysis/REPORTS/CROATIA_REGIONAL_LEVEL/Report_Risk_and_Vulnerability_Region_of_Istria.pdf, p.32, 49, 70

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https://ida.hr/hr/bn/eu-projekti/aktualni-eu-projekti/detail/2/life-sec-adapt-upgrading-sustainable-energy-communities-mayor-adapt-initiative-planning-climate-change-adaptation-strategies/

https://www.istra-istria.hr/index.php?id=263

https://www.istra-istria.hr/index.php?id=14</td></tr>
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Images

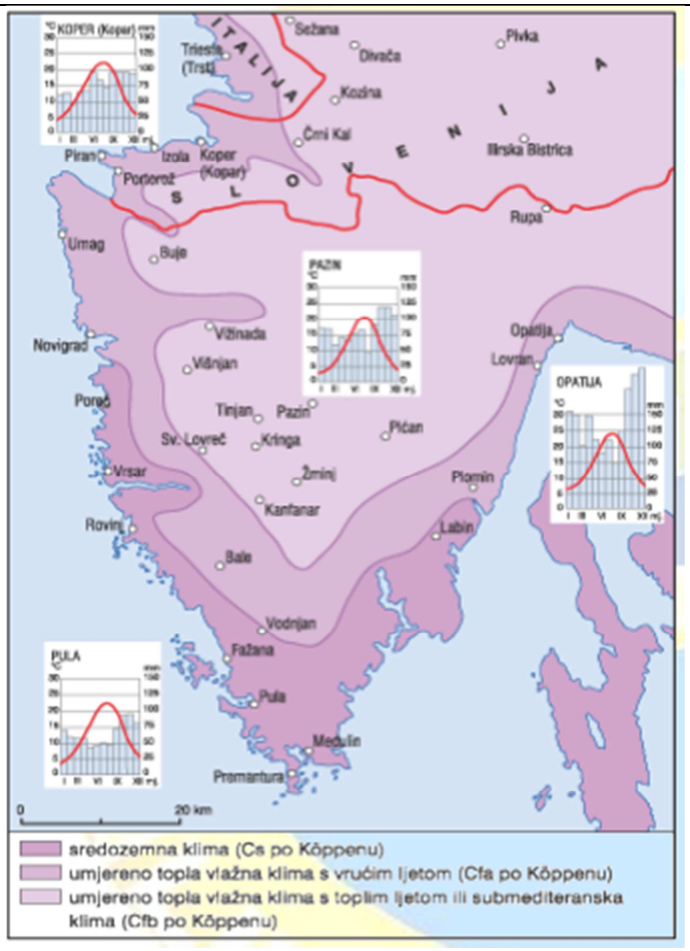

Image 1 - Climatological view of Istria

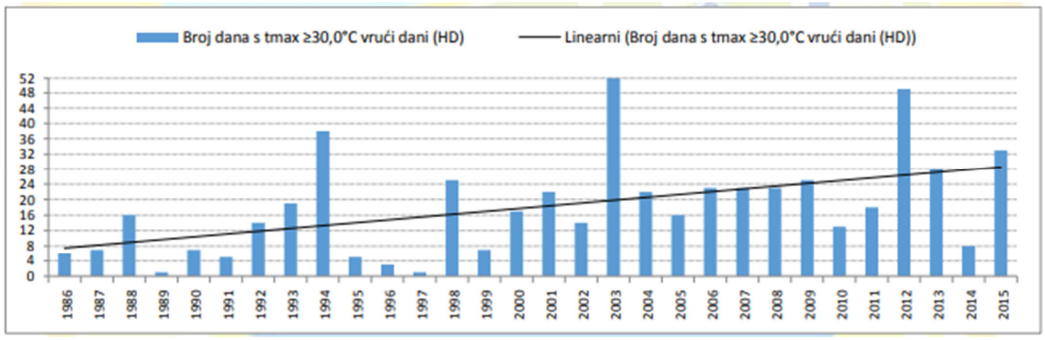

Image 2 – Representation of number of days with daily temperature equal or higher than 30 30,0 °C (hot days) in western Istria in 1986 – 2015 year period