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STRENGTHENING THE CAPACITY OF REGIONAL AND LOCAL ADMINISTRATIONS FOR IMPLEMENTATION AND ENFORCEMENT OF EU ENVIRONMENTAL AND CLIMATE CHANGE LEGISLATION AND DEVELOPMENT OF INFRASTRUCTURE PROJECTS

EuropeAid/140209/DH/SER/UA

Methodology for the drafting of Climate Change Adaptation Strategies and Implementation Plans in the three pilot Oblasts

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APENA 3	Strengthening the capacity of regional and local administrations for implementation and enforcement of EU environmental and climate change legislation and development of infrastructure projects (EuropeAid/140209/DH/SER/UA)
AR5	Fifth Assessment Report (of IPCC)
CMIP5	Coupled Model Intercomparison Project Phase 5
CORDEX	Coordinated Regional Downscaling Experiment
EU	European Union
GMST	Global Mean Surface Temperature
IPCC	Intergovernmental Panel on Climate Change
RCM	Regional Climate Model
RCP	Representative Concentration Pathway
RSA	Regional State Administration

1. Component 3 Synopsis

This document presents the methodological basis for the elaboration of the Tasks and Sub-tasks under Component 3 of the project “**Strengthening the capacity of regional and local administrations for implementation and enforcement of EU environmental and climate change legislation and development of infrastructure projects – EuropeAid/140209/DH/SER/UA”**.

In the following chapters are described the methodological steps and the tools that will be taken into consideration in order to create a detailed and quantifiable risk and vulnerability assessment, for the different sectors of the economy and the natural environment, as well as the geographic areas in the three pilot Oblasts in Ukraine.

An overview of the structure of project APENA3, Component 3 is presented in the following table.

Table 1: Brief structure of Component 3

Component 3. Development of regional climate adaptation strategies with implementation plan	
Task 3.1	**Preparation of climate adaptation strategies for three (3) pilot oblasts, including climate vulnerability assessment and resilience measures and adaptation costs**
Sub-task 3.1.1	Identification of Pilot Oblasts
Sub-task 3.1.2	Preparation of Climate Adaptation Strategies for 3 pilot Oblasts
Task 3.2	**Preparation of climate adaptation implementation plans for three (3) pilot oblasts**
Sub-task 3.2.1	Development of Action Plan
Sub-task 3.2.2	Impact of the proposed measures and actions
Sub-task 3.2.3	Preparation of climate adaptation implementation plans
Task 3.3	**Assistance in the approval process and public consultations on pilot strategies and plans**
Sub-task 3.3.1	Public consultation and approval process
Task 3.4	**Preparation of communication plans for each climate adaptation strategy**
Sub-task 3.4.1	Development of a communication plan for each climate adaptation strategy

<u>Selection process of the three pilot Oblasts</u>

As identified in the table above, a main feature of Component 3 is the development of climate change adaptation strategies followed by implementation plans for three Ukrainian Oblasts.

Initially, the project team was tasked with selecting the three most appropriate Ukrainian Oblasts, from a pre-determined suite of eight located in the Carpathian Region, the Black Sea Region and the Western Buh river basin.

Questionnaires were designed to gather climate-related data from each Oblast’s Regional State Administration (RSA) as a mean of assessing which three of the short-listed Oblasts were currently best suited towards undertaking exemplary pilot strategies and implementation plans.

The selection process involved distributing the questionnaires, which were ratified for circulation by beneficiary counterparts, to the relevant Regional State Administrations and evaluating feedback.

Transparent assessment of the questionnaire responses involved utilization of a quantitative scoring system coupled with expert qualitative analysis. The appraisal process provided project team Experts with ample sustenance to determine the most appropriate Oblasts.

Following the evaluation process, the Oblasts of **Ivano-Frankivs’ka**, **L’vivs’ka** and **Mykolaivs’ka** were determined to be the most appropriate in which to undertake pilot climate change adaptation strategies and related implementation plans.

2. Introduction to Climate Change

Climate change has been taking place since the end of the 19th century and its impacts are becoming more and more noticeable in Europe and worldwide. The global temperature rise is the most remarkable change and is largely attributed to the change in the composition of the atmosphere due to the anthropogenic activities. This anthropogenic component of climate change has been linked to fossil fuel use and carbon dioxide emissions.

Today, the global average temperature is over 1.0 °C higher than it was in pre-industrial times, and continues to rise, with the value in Europe growing faster than the global average. Specifically, based on the IPCC 6th Assessment Report "Global surface temperature was 1.09 [0.95 to 1.20] °C higher in 2011–2020 than 1850–1900, with larger increases over land (1.59 [1.34 to 1.83] °C) than over the ocean (0.88 [0.68 to 1.01] °C)".

One of direct consequences from the constant temperature rise is sea level rise due to thermosteric ocean expansion and melting of glaciers and ice sheets. Significant changes in the global climate also include changes in the amount of precipitation and the more intense and frequent extreme weather and climate events such as droughts, heat waves, floods, extreme winds, storms, wildfire weather etc. The above-mentioned weather phenomena lead to serious implications for the integrity of ecosystems, water resources, public health, food supply, industry, agriculture, transport and infrastructure.

The impacts of climate change vary by geographical area, depending on climatic, geographical and socio-economic conditions. In Europe, all regions are exposed to climate change, with the Mediterranean basin, mountainous areas, densely populated floodplains, coastal zones and the Arctic at greater risk. In addition, it is noted that 3/4 of Europe's population lives in urban areas, which do not have the necessary capacity to adapt to climate change and are exposed to heat waves, droughts, floods or sea level rise.

In order to avoid the most serious risks from climate change and, in particular, large-scale, irreversible effects, global warming must be kept well below 2 °C relative to pre-industrial levels accordingly with the Paris accord. Therefore, mitigating climate change must continue to be a priority for the international community. Of course, regardless of the scenarios for global warming and the success of mitigation efforts, the impacts of climate change will increase in the coming decades due to the delayed impact of past and present greenhouse gas emissions. Therefore, adaptation measures to address the inevitable effects of climate change and their economic, environmental and social costs are essential.

In conclusion, actions to tackle climate change must include a change of the existing growth model, towards a sustainable, green economy with low and/or zero carbon emissions using modern technology. The development of this model should be based on the horizontal coordination of mitigation and adaptation policies, in the fields of energy, industry, agricultural production and many others. It is noted that the cost of reducing emissions and adapting to climate change may initially seem high, but it is very low compared to the cost we will have to pay due to the inaction.

Finally, in order to emphasize the importance of the problem of climate change, it is worth mentioning that according to the report of the World Economic Forum for 2020, four of the five most serious global risks are associated with climate change and relate to extreme weather events, habitat loss, water crisis and the inability to mitigate and adapt to climate change.

3. Identification of Sectors of interest

The first important step in this methodological process was to identify the sectors of interest in relation to climate change, in Oblast but also National level utilizing the experiences and know-how from Europe and internationally, since the pilot Strategies and Implementation Plans, will be used as a guidance for other Oblasts in the future to elaborate regional climate change adaptation planning.
Through desk research, literature review and following the site visits to the pilot Oblasts (October 2021), the Experts team prepared the list of sectors (and subsectors) of interest for which a detailed - quantifiable vulnerability and risk assessment will take place, followed by an extensive proposal and evaluation of measures to enhance the resilience against the impacts of climate change of different sectors of the economy and the environment and the geographic areas in the three pilot Oblasts.
The list of the proposed sectors of interest is presented in the following table.

Table 2: Proposed sectors of interest for the elaboration of the Strategies and Implementation Plans in the pilot Oblasts

A/a	Name of sector / subsector	Pilot Oblasts	EU Policy Sectors
1	Agriculture		Agriculture
1.1	Farming	all three Oblasts	
1.2	Livestock	all three Oblasts	
2	Forests (forest fires)	all three Oblasts	Forestry
3	Biodiversity and ecosystems		Biodiversity / Ecosystem based approaches / Forestry
3.1	Protected areas	all three Oblasts	
3.2	Forest ecosystems, reforestations – rehabilitation of forests	all three Oblasts	
4	Water management		Water management
4.1	Water resources	all three Oblasts	
4.2	Floods	all three Oblasts	
5	Fisheries	Mykolaivs'ka Oblast	Marine & Fisheries
6	Coastal areas	Mykolaivs'ka Oblast	Coastal areas
7	Tourism		Biodiversity / Buildings / Coastal areas / Disaster risk reduction / Energy / Health / Water Management
7.1	General tourism and special forms of tourism (e.g. ecotourism)	all three Oblasts	
7.2	General tourism, special forms of tourism (e.g. ecotourism, religious tourism) and winter tourism	Ivano-Frankivs'ka Oblast L'vivs'ka Oblast	
7.3	General tourism and summer tourism	all three Oblasts	
8	Critical infrastructure		Disaster risk reduction / Buildings / Coastal areas / Energy / Health / Transport / Urban / Water management
8.1	Land transport network (roads & railways)	all three Oblasts	
8.2	Airports	all three Oblasts	
8.3	Ports	Mykolaivs'ka Oblast	
8.4	Energy infrastructure	all three Oblasts	
8.5	Industries	all three Oblasts	
9	Health sector (diseases, discomfort etc.)	all three Oblasts	Health
10	Built environment	all three Oblasts	Buildings / Urban
11	Cultural heritage	all three Oblasts	Disaster risk reduction / Buildings

*** 11 Sectors of interest (20 in total with the sub-sectors)**

4. Vulnerability and Risk Assessment Methodology

4.1 Vulnerability Assessment

The definition of vulnerability is the following:

Vulnerability = Sensitivity x Exposure[1]

The next steps will be taken to assess the vulnerability of individual sectors and geographic areas of each Oblast to climate change, which are described in detail in the following paragraphs:

STEP 1	Selection of the sectors for which the vulnerability assessment will be performed
STEP 2	Selection of the appropriate indices to evaluate the impact of each climatic impact driver to each sector
STEP 3	Sensitivity analysis of each sector to climate change
STEP 4	Exposure analysis for each sector to climate change
STEP 5	Vulnerability assessment of the different sectors and geographic areas

The **climatic impact drivers** for which the vulnerability assessment will be carried under this assignment are:

- Temperature rise;
- Drought;
- Windstorms;
- Heat waves;
- Cold invasions / frost;
- Extreme precipitation;
- Snowcover decrease and
- Sea level rise.

The Experts' team is working towards relating the above Climatic Impact Drivers with the latest

[1] THE BASICS OF CLIMATE CHANGE ADAPTATION VULNERABILITY AND RISK ASSESSMENT (JASPERS Guidance Note, June 2017)

developments in the 6th IPCC Assessment Report – Working Group 1 contribution (IPCC, 2021). The detailed vulnerability assessment that follows, will be presented in Chapter 3 of the Climate Adaptation Strategies for the three pilot Oblasts.

4.1.1 Selected sectors for the vulnerability assessment (Step 1)

As described in chapter 3, eleven (11) sectors of interest (20 in total with the sub-sectors) were identified from the project team, which will be analysed during the elaboration of the Strategies and the Implementation Plans.

4.1.2 Selection of indices to evaluate the impact of each climatic impact driver to each sector (Step 2)

The project team defined a pool of main and supporting climate indices that will be projected for future time horizons in different Representative Concentration Pathway (RCP) scenarios according to IPCC. The full list of proposed climate indices is presented in Chapter 6.

It must be noted that since climate change does not affect all sectors in the same way, different climate indices for every sector and climatic impact driver should be used. For the vulnerability assessment, we selected indices that are considered through international literature, guidance documents and other strategies and plans as the most appropriate to showcase the impact of climate change in each sector / climatic impact driver.
Therefore, a selection from the above-mentioned climate indices (main and supporting) can be used for the vulnerability assessment. The matrix presented in following table, shall be used to identify which indices (associated with the respective climatic impact drivers) shall be used for the vulnerability assessment of each sector.

Since this is a working document and its updates will be illustrated in Chapter 3 of the Climate Adaptation Strategies, our Experts' team is working towards relating the climate indices selection with the Climatic Impact Drivers, proposed in the 6th IPCC Assessment Report – Working Group 1 contribution (IPCC, 2021).

It must be noted that this is an initial proposal, drafted by our Experts' team.
The team is currently working in the process of evaluating the proposed climate indices for the vulnerability and risk assessment.
Extensive consultation with different levels of stakeholders will follow, in all stages of the elaboration and institutionalization.
The final version of the table will be presented in Chapter 3 of the Climate Adaptation Strategies.

Table 3: Matrix of climate indices to be used for the vulnerability assessment of each sector

Climatic impact driver	Indices	Agriculture		Forests (Fires)	Biodiversity and ecosystems		Water management		Fisheries	Coastal areas	Tourism			Critical infrastructure					Health	Built environment	Cultural heritage
		Farming	Livestock		Protected areas	Forest ecosystems	Water resources	Floods			L'vivs'ka Oblast	Ivano-Frankivs'ka Oblast	Mykolaivs'ka Oblast	Land transport	Airports	Ports	Energy Infrastructure	Industries			
Temperature rise	Near-Surface Air Temperature change	√			√		√	√	√					√	√	√					
	Fire Weather Index (FWI) > 30 (high and very high risk of forest fire) change			√		√															
	Summer daily maximum mean air temperature change												√						√		
	Cooling Degree Days (CDD) change																√	√	√	√	
	Daily Maximum Near-Surface Air Temperature change		√							√	√	√					√	√		√	√
	Growing season change	√			√	√															
	Days with Beach Climate Index (BCI) > 80 (excellent beach conditions) change									√			√								
	Days with Tourism Climate Index (TCI) > 90 (ideal conditions for tourism) change										√	√									
Drought	Consecutive (duration) dry days – dry max spell change	√	√	√	√		√	√			√	√	√	√	√	√	√	√	√	√	√
	Mean annual precipitation percent change	√	√	√	√	√	√			√							√			√	
Windstorms	Mean wind speed change during fire season (March – October)			√																	
	Days with maximum wind speed > 10,8 m/sec (> 6 beaufort) change during summer			√									√								
	Days with maximum wind speed > 10,8 m/sec (> 6 beaufort) change	√	√		√	√			√	√	√	√		√	√	√	√	√			
Heat waves	Days with maximum daily mean air temperature > 30 ºC change	√		√	√	√					√	√	√	√		√	√	√			
	Humidex index > 37 (great discomfort) change										√	√	√						√	√	
	Tropical nights change		√							√							√	√	√	√	√
Cold invastions / Frost	Night frosts change		√		√									√	√					√	
	Total frosts (ice days) change	√				√					√	√	√				√	√	√		
	Consecutive days (duration) with minimum mean air temperature < -10 ºC (cold spell) change	√	√		√	√					√	√	√	√	√		√	√	√	√	
Extreme precipitation	Maximum 5-day precipitation percent change	√	√		√	√					√	√	√	√	√	√			√	√	√
	Maximum 1-day precipitation change	√	√		√	√					√	√	√				√	√			√
	Days with precipitation value > 99th percentile of the historical period (extreme precipitation)						√	√		√				√	√	√	√	√	√	√	

Climatic impact driver	Indices	Agriculture		Forests (Fires)	Biodiversity and ecosystems		Water management		Fisheries	Coastal areas	Tourism			Critical infrastructure					Health	Built environment	Cultural heritage
		Farming	Livestock		Protected areas	Forest ecosystems	Water resources	Floods			L'vivs'ka Oblast	Ivano-Frankivs'ka Oblast	Mykolaivs'ka Oblast	Land transport	Airports	Ports	Energy Infrastructure	Industries			
Snowfall decrease	Mean annual snowfall percent change	√	√				√							√	√		√	√		√	√
	Snowfall days change										√	√							√		
	Surface Snow Amount										√	√									
Sea level rise	Sea level rise	√	√		√	√	√	√	√	√			√	√	√	√	√	√		√	√
	Storm surges change				√			√		√			√								

*** This is the initial proposal of the matrix table. It is open to revision based on the feedback from the different levels of stakeholders.**
**** Tables were filled out using the following symbol for a selected climate index: √**

4.1.3 Sensitivity analysis (Step 3)

The purpose of this Step is to assess the sensitivity that is expected for every sector in each climatic impact driver in the pilot Oblasts.
The assessment in the context of the study will be based on the responses of the local RSAs on our questionnaires, reports, data and studies that will be provided additionally to the questionnaires and studies, papers etc. from Ukrainian and international literature that focus on how climate change impacts the various sectors.

Based on the above information, the following Table presents the analysis of the sensitivity of each sector to each climatic impact driver, using the following normalized scale:

- Negligible sensitivity: 0
- Low sensitivity: 1
- Medium sensitivity: 2
- High sensitivity: 3
- Very high sensitivity: 4

For example, water resources sector is very sensitive to droughts, due to reduced water supply and renewal of the aquifers, increased water demand, etc. compared to the fisheries sector which is not affected. Conversely, water resources are not affected by heat waves (they are practically influenced by the general temperature rise and not by temperature extremes), while the built environment sector is directly affected by heat waves (very sensitive).

It must be noted that this is an initial proposal, drafted by our Experts' team.
The team is currently working in the process of evaluating the proposed climate indices for the vulnerability and risk assessment.
Extensive consultation with different levels of stakeholders will follow, in all stages of the elaboration and institutionalization.
The final version of the table will be presented in Chapter 3 of the Climate Adaptation Strategies.

Table 4: Sensitivity analysis matrix for each sector to each climatic impact driver, taking into consideration the representative indices selected

Sector		Climatic Impact Driver													
		Temperature rise		Drought		Windstorms		Heat waves	Cold invasions / Frost		Extreme precipitation		Snowfall decrease	Sea level rise	
Agriculture	Farming	Near-Surface Air Temperature change	Growing season change	Consecutive (duration) dry days – dry max spell change	Mean annual precipitation percent change	Days with maximum wind speed > 10,8 m/sec (> 6 beaufort) change		Days with maximum daily mean air temperature > 30 oC change	Total frost (ice days) change	Consecutive days (duration) with minimum mean air temperature < -10 oC (cold spell) change	Maximum 5-day precipitation percent change	Maximum 1-day precipitation change	Mean annual snowfall percent change	Sea level rise	
		2	1	2	2	1		1	1	1	1,5	1,5	1	4	
	Livestock	Daily Maximum Near-Surface Air Temperature change		Consecutive (duration) dry days – dry max spell change	Mean annual precipitation percent change	Days with maximum wind speed > 10,8 m/sec (> 6 beaufort) change		Tropical nights change	Night frost change	Consecutive days (duration) with minimum mean air temperature < -10 oC (cold spell) change	Maximum 5-day precipitation percent change	Maximum 1-day precipitation change	Mean annual snowfall percent change	Sea level rise	
		2		1	1	1		2	0,5	0,5	1	1	1	4	
Forests (fires)		Fire Weather Index (FWI) > 30 (high and very high risk of forest fire) change		Consecutive (duration) dry days – dry max spell change	Mean annual precipitation percent change	Mean wind speed change during fire season (March – October)	Days with maximum wind speed > 10,8 m/sec (> 6 beaufort) change during summer	Days with maximum daily mean air temperature > 30 oC change	N/A		N/A		N/A	N/A	
		4		1	1	1,5	1,5	2	0		0		0	0	
Biodiversity and ecosystems	Protected areas	Near-Surface Air Temperature change	Growing season change	Consecutive (duration) dry days – dry max spell change	Mean annual precipitation percent change	Days with maximum wind speed > 10,8 m/sec (> 6 beaufort) change		Days with maximum daily mean air temperature > 30 oC change	Night frost change	Consecutive days (duration) with minimum mean air temperature < -10 oC (cold spell) change	Maximum 5-day precipitation percent change	Maximum 1-day precipitation change	N/A	Sea level rise	Storm surges change
		1	1	1,5	1,5	1		2	0,5	0,5	1,5	1,5	0	3	1
	Forest ecosystems	Fire Weather Index (FWI) > 30 (high and very high risk of forest fire) change	Growing season change	Mean annual precipitation percent change		Days with maximum wind speed > 10,8 m/sec (> 6 beaufort) change		Days with maximum daily mean air temperature > 30 oC change	Total frost (ice days) change	Consecutive days (duration) with minimum mean air temperature < -10 oC (cold spell) change	Maximum 5-day precipitation percent change	Maximum 1-day precipitation change	N/A	Sea level rise	
		0,5	1,5	3		1		1	0,5	0,5	2	2	0	4	
Water management	Water resources	Near-Surface Air Temperature change		Consecutive (duration) dry days – dry max spell change	Mean annual precipitation percent change	N/A		N/A	N/A		Days with precipitation value > 99th percentile of the historical period (extreme precipitation)		Mean annual snowfall percent change	Sea level rise	
		1		2	2	0		0	0		3		2	4	
	Floods	Near-Surface Air Temperature change		Consecutive (duration) dry days – dry max spell change		N/A		N/A	N/A		Days with precipitation value > 99th percentile of the historical period (extreme precipitation)		N/A	Sea level rise	Storm surges change
		1		2		0		0	0		4		0	3	1
Fisheries		Near-Surface Air Temperature change		N/A		Days with maximum wind speed > 10,8 m/sec (> 6 beaufort) change		N/A	N/A		N/A		N/A	Sea level rise	
		2		0		2		0	0		0		0	4	
Coastal areas		Daily Maximum Near-Surface Air Temperature change	Days with Beach Climate Index (BCI) > 80 (excellent beach conditions) change	Mean annual precipitation percent change		Days with maximum wind speed > 10,8 m/sec (> 6 beaufort) change		Tropical nights change	N/A		Days with precipitation value > 99th percentile of the historical period (extreme precipitation)		N/A	Sea level rise	Storm surges change
		2	2	1		3		1	0		3		0	3	1

Sector		Climatic Impact Driver														
		Temperature rise		Drought		Windstorms	Heat waves		Cold invasions / Frost		Extreme precipitation		Snowfall decrease		Sea level rise	
Tourism	L'vivs'ka Oblast	Daily Maximum Near-Surface Air Temperature change	Days with Tourism Climate Index (TCI) > 90 (ideal conditions for tourism) change	Consecutive (duration) dry days – dry max spell change		Days with maximum wind speed > 10,8 m/sec (> 6 beaufort) change	Days with maximum daily mean air temperature > 30 oC change	Humidex index > 37 (great discomfort) change	Total frost (ice days) change	Consecutive days (duration) with minimum mean air temperature < -10 oC (cold spell) change	Maximum 5-day precipitation percent change	Maximum 1-day precipitation change	Snowfall days change	Surface Snow Amount	N/A	
		2	1	1		2	3	1	0,5	0,5	1	1	1	1	0	
	Ivano-Frankivs'ka Oblast	Daily Maximum Near-Surface Air Temperature change	Days with Tourism Climate Index (TCI) > 90 (ideal conditions for tourism) change	Consecutive (duration) dry days – dry max spell change		Days with maximum wind speed > 10,8 m/sec (> 6 beaufort) change	Days with maximum daily mean air temperature > 30 oC change	Humidex index > 37 (great discomfort) change	Total frost (ice days) change	Consecutive days (duration) with minimum mean air temperature < -10 oC (cold spell) change	Maximum 5-day precipitation percent change	Maximum 1-day precipitation change	Snowfall days change	Surface Snow Amount	N/A	
		2	1	1		2	3	1	0,5	0,5	1	1	1	1	0	
	Mykolaivs'ka Oblast	Summer daily maximum mean air temperature change	Days with Beach Climate Index (BCI) > 80 (excellent beach conditions) change	Consecutive (duration) dry days – dry max spell change		Days with maximum wind speed > 10,8 m/sec (> 6 beaufort) change during summer	Days with maximum daily mean air temperature > 30 oC change	Humidex index > 37 (great discomfort) change	Total frost (ice days) change	Consecutive days (duration) with minimum mean air temperature < -10 oC (cold spell) change	Maximum 5-day precipitation percent change	Maximum 1-day precipitation change	N/A		Sea level rise	Storm surges change
		2	1	1		2	3	1	0,5	0,5	1	1	0		3	1
Critical infrastructure	Land transport	Near-Surface Air Temperature change		Consecutive (duration) dry days – dry max spell change		Days with maximum wind speed > 10,8 m/sec (> 6 beaufort) change	Days with maximum daily mean air temperature > 30 oC change		Night frost change	Consecutive days (duration) with minimum mean air temperature < -10 oC (cold spell) change	Maximum 5-day precipitation percent change	Days with precipitation value > 99th percentile of the historical period (extreme precipitation)	Mean annual snowfall percent change		Sea level rise	
		1		1		1	1		1	1	1	2	1		4	
	Airports	Near-Surface Air Temperature change		Consecutive (duration) dry days – dry max spell change		Days with maximum wind speed > 10,8 m/sec (> 6 beaufort) change	N/A		Night frost change	Consecutive days (duration) with minimum mean air temperature < -10 oC (cold spell) change	Maximum 5-day precipitation percent change	Days with precipitation value > 99th percentile of the historical period (extreme precipitation)	Mean annual snowfall percent change		Sea level rise	
		1		1		2	0		0,5	0,5	1	1	1		4	
	Ports	Near-Surface Air Temperature change		Consecutive (duration) dry days – dry max spell change		Days with maximum wind speed > 10,8 m/sec (> 6 beaufort) change	Days with maximum daily mean air temperature > 30 oC change		N/A		Maximum 5-day precipitation percent change	Days with precipitation value > 99th percentile of the historical period (extreme precipitation)	N/A		Sea level rise	
		1		1		3	1		0		1	1	0		4	
	Energy infrastructure	Cooling Degree Days (CDD) change	Daily Maximum Near-Surface Air Temperature change	Consecutive (duration) dry days – dry max spell change	Mean annual precipitation percent change	Days with maximum wind speed > 10,8 m/sec (> 6 beaufort) change	Days with maximum daily mean air temperature > 30 oC change	Tropical nights change	Total frost (ice days) change	Consecutive days (duration) with minimum mean air temperature < -10 oC (cold spell) change	Maximum 1-day precipitation change	Days with precipitation value > 99th percentile of the historical period (extreme precipitation)	Mean annual snowfall percent change		Sea level rise	
		1	1	1	1	1	2	1	0,5	0,5	1	2	1		4	
	Industries	Cooling Degree Days (CDD) change	Daily Maximum Near-Surface Air Temperature change	Consecutive (duration) dry days – dry max spell change		Days with maximum wind speed > 10,8 m/sec (> 6 beaufort) change	Days with maximum daily mean air temperature	Tropical nights change	Total frost (ice days) change	Consecutive days (duration) with minimum mean air temperature	Maximum 1-day precipitation change	Days with precipitation value > 99th percentile of the historical period (extreme precipitation)	Mean annual snowfall percent change		Sea level rise	

Sector	Climatic Impact Driver												
	Temperature rise		Drought		Windstorms	Heat waves		Cold invasions / Frost		Extreme precipitation		Snowfall decrease	Sea level rise
						> 30 oC change			< -10 oC (cold spell) change				
	1	1	1		1	2	1	0,5	0,5	1	2	1	4
Health	Summer daily maximum mean air temperature change	Cooling Degree Days (CDD) change	Consecutive (duration) dry days – dry max spell change		N/A	Humidex index > 37 (great discomfort) change	Tropical nights change	Total frost (ice days) change	Consecutive days (duration) with minimum mean air temperature < -10 oC (cold spell) change	Maximum 5-day precipitation percent change	Days with precipitation value > 99th percentile of the historical period (extreme precipitation)	Snowfall days change	N/A
	2	1	1		0	2	2	1	1	1	1	1	0
Built environment	Cooling Degree Days (CDD) change	Daily Maximum Near-Surface Air Temperature change	Consecutive (duration) dry days – dry max spell change	Mean annual precipitation percent change	N/A	Humidex index > 37 (great discomfort) change	Tropical nights change	Night frost change	Consecutive days (duration) with minimum mean air temperature < -10 oC (cold spell) change	Maximum 5-day precipitation percent change	Days with precipitation value > 99th percentile of the historical period (extreme precipitation)	Mean annual snowfall percent change	Sea level rise
	1	1	1	1	0	1,5	1,5	0,5	0,5	1	2	1	4
Cultural heritage	Daily Maximum Near-Surface Air Temperature change		Consecutive (duration) dry days – dry max spell change		N/A	Tropical nights change		N/A		Maximum 5-day precipitation percent change	Maximum 1-day precipitation change	Mean annual snowfall percent change	Sea level rise
	1		1		0	2		0		1	2	1	4

Sensitivity legend	
0	Negligible
1	Low
2	Medium
3	High
4	Very high

*** This is the initial proposal of the sensitivity table. It is open to revision based on the feedback from the different levels of stakeholders.**
**** A maximum amount of two climate indices (the most representative) are used to describe the climatic impact driver for every sector.**
***** In that case the maximum total amount of sensitivity for the climatic impact driver will be maximum 4 (according to the normalization methodology).**

4.1.4 Exposure analysis (Step 4)

The climate indices selected and associated with climatic impact drivers in Step 2, will be used to describe the degree of exposure of each grid point of the study area, to climatic impact drivers, based on the following normalized scale:

- Negligible exposure: 0
- Low exposure: 1
- Medium exposure: 2
- High exposure: 3
- Very high exposure: 4

The approach for the correlation of each index change (i.e. change between the reference period and the short-term horizon in each RCP scenario) with the degree of exposure will be presented in the format of the table below. For example, a change in the near-surface air temperature (tas), compared to the reference period which is higher or equal to 4 °C, is considered to correspond to a very high degree of exposure, while a change between 1 and 2 °C, is considered to correspond to a medium degree of exposure.

It must be noted that this is an initial proposal, drafted by our Experts' team. It is open to revision based on the feedback from the different levels of stakeholders.
The team is currently working in the process of evaluating the proposed climate indices for the vulnerability and risk assessment.
Extensive consultation with different levels of stakeholders will follow, in all stages of the elaboration and institutionalization.
The final version of the table will be presented in Chapter 3 of the Climate Adaptation Strategies.

Table 5: Characterization of the degree of exposure to different climatic impact drivers based on representative indices change

Climatic impact driver	Indices	Units	Negligible 0	Low 1	Medium 2	High 3	Very high 4
Temperature rise	Near-Surface Air Temperature change	ºC	Δ < 0,5	0,5 ≤ Δ < 1	1 ≤ Δ < 2	2 ≤ Δ < 4	Δ ≥ 4
	Fire Weather Index (FWI) > 30 (high and very high risk of forest fire) change	d/y	Δ < 3	3 ≤ Δ < 10	10 ≤ Δ < 20	20 ≤ Δ < 40	Δ ≥ 40
	Summer daily maximum mean air temperature change	ºC	Δ < 0,5	0,5 ≤ Δ < 1	1 ≤ Δ < 2	2 ≤ Δ < 4	Δ ≥ 4
	Cooling Degree Days (CDD) change	dd/y	Δ < 50	50 ≤ Δ < 200	200 ≤ Δ < 300	300 ≤ Δ < 500	Δ ≥ 500
	Daily Maximum Near-Surface Air Temperature change	ºC	Δ < 0,5	0,5 ≤ Δ < 1	1 ≤ Δ < 2	2 ≤ Δ < 4	Δ ≥ 4
	Growing season change	d/y	Δ > 0	-5 ≤ Δ < 0	-10 ≤ Δ < -5	-15 ≤ Δ < -10	Δ ≤ -15
	Days with Beach Climate Index (BCI) > 80 (excellent beach conditions) change	d/y	Δ < -2	-2 ≤ Δ < -5	-5 ≤ Δ < -10	-10 ≤ Δ < -15	Δ ≥ -15

Climatic impact driver	Indices	Units	Negligible 0	Low 1	Medium 2	High 3	Very high 4
	Days with Tourism Climate Index (TCI) > 90 (ideal conditions for tourism) change	d/y	Δ < -2	-2 ≤ Δ < -5	-5 ≤ Δ < -10	-10 ≤ Δ < -15	Δ ≥ -15
Drought	Consecutive (duration) dry days – dry max spell change	d/y	Δ < 3	3 ≤ Δ < 10	10 ≤ Δ < 15	15 ≤ Δ < 20	Δ ≥ 20
	Mean annual precipitation percent change	%	Δ > -3	-3 ≥ Δ > -5	-5 ≥ Δ > -10	-10 ≥ Δ > -15	Δ ≤ -15
Windstorms	Mean wind speed change during fire season (March – October)	d/y	Δ < 0	0 ≤ Δ < 4	4 ≤ Δ < 8	8 ≤ Δ < 12	Δ ≥ 12
	Days with maximum wind speed > 10,8 m/sec (> 6 beaufort) change during summer	d/y	Δ < 0	0 ≤ Δ < 2	2 ≤ Δ < 4	4 ≤ Δ < 6	Δ ≥ 6
	Days with maximum wind speed > 10,8 m/sec (> 6 beaufort) change	d/y	Δ < 0	0 ≤ Δ < 4	4 ≤ Δ < 8	8 ≤ Δ < 12	Δ ≥ 12
Heat waves	Days with maximum daily mean air temperature > 30 °C change	d/y	Δ < 2	2 ≤ Δ < 5	5 ≤ Δ < 10	10 ≤ Δ < 15	Δ ≥ 15
	Humidex index > 37 (great discomfort) change	d/y	Δ < 10	10 ≤ Δ < 20	20 ≤ Δ < 30	30 ≤ Δ < 50	Δ ≥ 50
	Tropical nights change	d/y	Δ < 10	10 ≤ Δ < 20	20 ≤ Δ < 30	30 ≤ Δ < 50	Δ ≥ 50
Cold invastions / Frost	Night frosts change	d/y	Δ < 0	0 ≤ Δ < 5	5 ≤ Δ < 10	10 ≤ Δ < 20	Δ ≥ 20
	Total frosts (ice days) change	d/y	Δ < 5	5 ≤ Δ < 10	10 ≤ Δ < 20	20 ≤ Δ < 30	Δ ≥ 30
	Consecutive days (duration) with minimum mean air temperature < -10 °C (cold spell) change	d/y	Δ < 0	0 ≤ Δ < 2	2 ≤ Δ < 5	5 ≤ Δ < 10	Δ ≥ 10
Extreme precipitation	Maximum 5-day precipitation percent change	%	Δ < 0	0 ≤ Δ < 5	5 ≤ Δ < 10	10 ≤ Δ < 20	Δ ≥ 20
	Maximum 1-day precipitation change	mm	Δ < 2	2 ≤ Δ < 4	4 ≤ Δ < 7	7 ≤ Δ < 10	Δ ≥ 10
	Days with precipitation value > 99th percentile of the historical period (extreme precipitation)	d/y	Δ < 0	0 ≤ Δ < 1	1 ≤ Δ < 3	3 ≤ Δ < 5	Δ ≥ 5
Snowfall decrease	Mean annual snowfall percent change	%	Δ > -10	-10 ≥ Δ > -25	-25 ≥ Δ > -50	-50 ≥ Δ > -70	Δ ≤ -70
	Snowfall days change	d/y	Δ > -3	-3 ≥ Δ > -5	-5 ≥ Δ > -10	-10 ≥ Δ > -15	Δ ≤ -15
	Surface Snow Amount	%	Δ > -5	-5 ≥ Δ > -10	-10 ≥ Δ > -25	-25 ≥ Δ > -50	Δ ≤ -50
Sea level rise	Sea level rise	m	Δ < 0,05	0,05 ≤ Δ < 0,15	0,15 ≤ Δ < 0,30	0,30 ≤ Δ < 0,45	Δ ≥ 0,45
	Storm surges change (height)	%	Δ<5	5 ≤ Δ < 10	10 ≤ Δ < 20	20 ≤ Δ < 30	Δ ≥ 30

*** The presented values and quantification of exposure are subject to change based on the extreme values that will come up after the evaluation of the different climate indices**

4.1.5 Vulnerability assessment (Step 5)

According to the 5th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, 2014), vulnerability is defined as the tendency or predisposition of a system to be negatively affected by climate change. Vulnerability covers a range of concepts and elements that include the sensitivity to degradation and the lack of capacity to adapt to climate change. A number of research papers are based on the above definition (Bates et al., 2008; IPCC 4th Assessment Report, 2007; IPCC 5th Assessment Report, 2014; IPCC SR1.5, 2018; Fussel and Klein, 2006) and have assessed vulnerability as a function of:

- the nature, magnitude and frequency of the climate change phenomena to which a system is exposed,

- sensitivity of a system to degradation

As mentioned above, vulnerability comes up as the function of sensitivity (Step 3) and exposure (Step 4).

Vulnerability = Sensitivity x Exposure

Vulnerability is assessed for each climatic impact driver separately, but in the end the degree of vulnerability is overall assessed using the following normalized scale (in terms of past climate):

- Negligible vulnerability: ≤ 0,25
- Low vulnerability: 0,25 - 0,50
- Medium vulnerability: 0,50 - 1,00
- High vulnerability: 1,00 - 1,50
- Very high vulnerability: > 1,50

The vulnerability assessment in each regional climate adaptation strategy shall be undertaken with two approaches:

- Geographic vulnerability: Investigates the geographic areas for each sector that are most vulnerable to climate change. In this case, vulnerability will be calculated only for the grid points which belong to the sector under investigation.

- Sectoral vulnerability: Investigates the sectors of the natural and anthropogenic environment that are most vulnerable to climate change and to which priority should be given to measures and actions. In this case, the sectoral vulnerability is the average vulnerability value of the grid points that correspond to geographic areas of the sector.

4.2 Identification of impacts

Based on the sensitivity assessment (step 1.3), the impacts that can affect each examined sector in Oblast level will be recorded.
Subsequently (in the same section), climate change will be associated with potential impacts (qualitative assessment), based on literature review and other available information. For this purpose, we will take into consideration (indicatively):
- Valuable information that will be provided in Oblast level, through detailed stakeholder engagement
- The results from the questionnaires and other information provided by the Oblast RSAs
- Deliverables from international and EU level projects in Ukraine, concerning the various sectors addressed in the climate change adaptation strategy and plan
- Available literature from local and international publications
- Guidance documents regarding climate change adaptation, sectoral risks etc.
- Guidance documents, such as the ones in the EU Climate-Adapt platform

It must be pointed out that in this section, the analysis focuses on the negative impacts of climate change, but there will be a distinct reference to the positive effects, where they might exist.
The negative impacts identified for each sector, will then be assessed (quantitively), based on their intensity, extent, probability of occurrence, complexity, time horizon, reversibility / minimization, and their interregional nature. This analysis will be the basis of the risk assessment (qualitative assessment) in the next stage of the methodology.

4.3 Risk Assessment

The aim of this task is to consider the likelihood and severity of each risk affecting the different sectors under evaluation.
The vulnerability assessment identified the climatic impact drivers that different sectors and geographic areas may be vulnerable to. These climatic impact drivers are then assessed in more detail to understand the level of probability (likelihood of impact) and the severity in case it happens (magnitude of impact), guiding us to evaluate the risk.
In order to understand the risks in more detail, it is important to understand the probability of the risk occurring (how likely it is to happen) and the severity of the impact if it did occur (the consequence of the risk).

The definition of risk is the following:

Risk = Probability x Severity

The following steps will be taken to assess the risk of individual sectors and geographic areas of each Oblast to climate change, which are described in detail in the following paragraphs:

STEP 1 Assessing the probability (likelihood of impact) of climatic impact drivers affecting each sector

STEP 2 Assessing the severity (magnitude of impact) of the consequence

STEP 3 Risk assessment

4.3.1 Probability assessment (likelihood of impact)

This part of the risk assessment looks at how likely the identified climatic impact drivers are to occur within a given timescale.
The output of the likelihood analysis will be summarized in a qualitative and/or quantitative estimation of the likelihood for each of the essential climatic impact drivers for each sector to occur.
The table below, describes the scale for the assessment of likelihood to the climatic impact drivers.

Table 6: Characterization of the likelihood of impact to each climatic impact driver for each sector

Scale of likelihood		Description	Chance of occurring
Rare	1	Highly unlikely to occur	5%
Unlikely	2	Given current practices and procedures, this incident is unlikely to occur	20%

Scale of likelihood		Description	Chance of occurring
Moderate	3	Incident has occurred in a similar geographic area / sector	50%
Likely	4	Incident is likely to occur	80%
Almost certain	5	Incident is very likely to occur, possibly several times	95%

4.3.2 Severity assessment (magnitude of impact)

This part of the risk assessment looks at what would happen if the identified climatic impact driver did occur, what would be the consequences. This should be assessed on a scale of severity per climatic impact driver. This is also referred to as magnitude.

The severity (magnitude) analysis will provide assessment of the potential impact for each of the climatic impact drivers in each sector. The magnitude scales from insignificant to catastrophic is presented in the following table:

Table 7: Characterization of the magnitude of impact (severity) to each climatic impact driver for each sector

Scale of magnitude		Description
Insignificant	1	Minimal impact that can be mitigated through normal activity
Minor	2	An event which effects the normal sectoral function, resulting in localized impacts of a temporary nature
Moderate	3	A serious event requiring additional actions to manage, resulting in moderate impacts
Major	4	A critical event requiring extraordinary action, resulting in significant, widespread or long-term impacts
Catastrophic	5	Disaster with the potential to lead to the collapse of the sector, causing significant harm and widespread long term impacts

4.3.3 Risk assessment

Having assessed the severity and probability of each climatic impact driver occurring, the significance level of each potential risk can be determined through a combination of the two factors. The risks can be plotted on a risk matrix to identify the most significant risks and those where future action is needed in terms of adaptation measures

The next table presents an example of a risk matrix.

Table 8: Risk matrix table

Risk matrix	Severity					
Likelihood		Insignificant	Minor	Moderate	Major	Catastrophic
	Rare	1	2	3	4	5
	Unlikely	2	4	6	8	10
	Moderate	3	6	9	12	15
	Likely	4	8	12	16	20
	Almost certain	5	10	15	20	25

Risk legend	
	Negligible
	Low

Risk legend	
	Medium
	High
	Very high

5. Proposed Table of Contents

Following the development of the vulnerability and risk assessment methodology, our project team, created the proposed tables of contents for the elaboration of the Climate Change Adaptation Strategies and Implementation Plans. They are presented in the following paragraphs.

5.1 Table of Contents – Pilot Oblasts Climate Change Adaptation Strategies

DRAFT REGIONAL CLIMATE CHANGE ADAPTATION STRATEGY

1 OBJECTIVES OF THE STRATEGY

1.1 OBJECT OF THE STRATEGY

1.2 CLIMATE CHANGE

1.3 CLIMATE CHANGE POLICY – INTERNATIONAL INSTITUTIONAL FRAMEWORK

1.4 OBJECTIVES AND PRINCIPLES

1.5 COMPATIBILITY OF THE STRATEGY WITH THE EXISTING NATIONAL STRATEGY ON CLIMATE ADAPTATION AND OTHER EXISTING RELEVANT PLANNING

1.5.1 COMPATIBILITY WITH THE NATIONAL STRATEGY ON CLIMATE ADAPTATION

1.5.2 COMPATIBILITY WITH THE EXISTING RELEVANT PLANNING IN NATIONAL AND OBLAST LEVEL

1.6 DATA AVAILABILITY AND SOURCES OF INFORMATION

1.7 IMPLEMENTATION AND MONITORING BODY

1.8 CONSORTIUM – EXPERTS TEAM

2 DATA AND ELEMENTS OF THE NATURAL AND ANTHROPOGENIC ENVIRONMENT (CURRENT STATE OF ENVIRONMENT)

2.1 CLIMATIC AND BIOCLIMATIC CHARACTERISTICS

2.1.1 CLIMATIC CHARACTERISTICS

2.1.1.1 CLIMATE DATA FROM EURO-CORDEX & E-OBS (PAST AND CURRENT CLIMATE)

2.1.1.2 CLIMATE DATA FROM METEOROLOGICAL STATIONS NETWORK (PAST AND CURRENT CLIMATE)

2.1.2 BIOCLIMATIC CHARACTERISTICS

2.2 MORPHOLOGICAL AND TOPOLOGICAL CHARACTERISTICS

2.2.1 MORPHOLOGICAL CHARACTERISTICS

2.2.2 TOPOLOGICAL CHARACTERISTICS

2.3 GEOLOGICAL, TECTONIC AND SOIL CHARACTERISTICS

2.3.1 GEOLOGICAL CHARACTERISTICS

2.3.2 TECTONIC CHARACTERISTICS

2.3.2.1 TECTONICS

2.3.2.2 SEISMICITY

2.3.2.3 HYDROGEOLOGY

2.3.3 SOIL CHARACTERISTICS

2.4 WATER RESOURCES

2.4.1 WATER MANAGEMENT PLANS

2.4.1.1 SURFACE WATER

2.4.1.2 GROUND WATER

2.4.1.3 PROTECTED WATER RESOURCES

2.4.2 FLOOD RISK MANAGEMENT PLANS

2.5 FLORA, FAUNA AND PROTECTED AREAS

2.5.1 VEGETATION

2.5.2 FLORA - FAUNA

2.5.3 FOREST ECOSYSTEMS

2.5.4 PROTECTED AREAS

5.2 Table of Contents – Pilot Oblasts Climate Change Adaptation Implementation Plans

6.8 INSTITUTIONAL STRUCTURE FOR ADAPTATION

6. Future Climate Projection

As described in Chapter 4, climate indices will be used to project the future climate phenomena. This is an important stage of the project component, as the vulnerability and risk assessment results will define the needs on resilience measures to be proposed during the implementation planning process.

6.1 Climate Change Scenarios

The Intergovernmental Panel on Climate Change (IPCC), issued in 2014 the 5th Assessment Report. According to the report, anthropogenic greenhouse gas emissions are generated mainly due to population size, economic activity, lifestyle, energy consumption, land use patterns, technology and climate policy.

Based on the estimates of the Fifth Assessment Report (AR5) of the IPCC, four Representative Concentration Pathways (RCPs) or Scenarios have been proposed, which are associated with time series of emissions of greenhouse gases, particles and chemical gases, as well as with land use changes. The key parameters that determine these four different scenarios are population growth rate, economic activity, lifestyle, energy sources, technological development, future land use and general policy on climate change. These scenarios include a mild scenario (RCP2.6), two moderate ones (RCP4.5 and RCP6.0) and a scenario with very high concentrations of greenhouse gases (RCP8.5). RCP2.6 is a representative scenario in which the increase in average global temperature compared to the pre-industrial era is estimated below 2 °C (IPCC, 2014).

The scenarios are named based on the additional anthropogenic radiative forcing in the year 2100, in relation to the pre-industrial period (2.6, 4.5, 6.0 and 8.5 W/m^2 respectively).

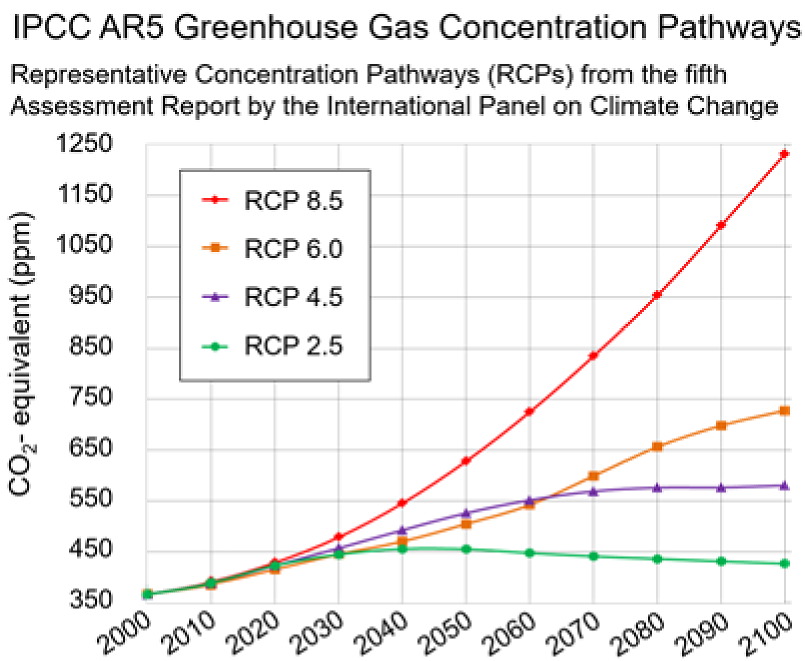

Figure 1: Evolution of CO2-eq concentrations from 2000 to 2100, for every RCP from the 5th IPCC Assessment Report

The Intergovernmental Panel on Climate Change (IPCC), in its Synthesis Report, has estimated the change in global mean temperature (°C) and global average sea level rise (m) for the four different

RCPs for a period of up to 2100. The values of the changes are presented in the following table.

Table 9: Global mean temperature rise and global average sea level rise according to the different RCPs of the 5th IPCC Assessment Report

Expected change according to IPCC 5th Assessment Report relative to 1986-2005					
		2046 – 2065		2081 - 2100	
	Scenario	**Mean value**	**Possible range**	**Mean value**	**Possible range**
Global mean temperature change (°C)	RCP2.6	1.0	Between 0.4 and 1.6	1.0	Between 0.3 and 1.7
	RCP4.5	1.4	Between 0.9 and 2.0	1.8	Between 1.1 and 2.6
	RCP6.0	1.3	Between 0.8 and 1.8	2.2	Between 1.4 and 3.1
	RCP8.5	2.0	Between 1.4 and 2.6	3.7	Between 2.6 and 4.8
Global average sea level rise (m)	RCP2.6	0.24	Between 0.17 and 0.32	0.40	Between 0.26 and 0.55
	RCP4.5	0.26	Between 0.19 and 0.33	0.47	Between 0.32 and 0.63
	RCP6.0	0.25	Between 0.18 and 0.32	0.48	Between 0.33 and 0.63
	RCP8.5	0.30	Between 0.22 and 0.38	0.63	Between 0.45 and 0.82

Source: IPCC 5th Assessment Report (IPCC, 2014)

6.2 Implementation of Climate Change Projections to the Pilot Oblasts

During the process of calculating the basic climatic indices and their application in the geographical area of the three pilot Oblasts, a set of Regional Climate Model (RCM) simulations of spatial resolution 0.11 ° x 0.11 ° will be used in order to optimize the results and reduce the error.

In terms of characteristics climate projection characteristics our project team suggests the following:

<u>Scenarios to be utilized according to IPCC</u>

In the context of the three pilot Strategies, the analysis of climate change trends will be carried out for two scenarios (Representative Concentration Pathways) of the 5th Assessment Report of the IPCC. Specifically, RCP4.5 and RCP8.5 are selected as they allow the analysis of the trends of the climate indices for an intermediate and worst-case scenario of the evolution of greenhouse gas emissions, respectively.

The analysis will be performed at the level of 20 years, for short-term (2021-2040), medium-term (2041-2060) and long-term (2081-2100) time horizons and the changes in the different time horizons and scenarios will be examined in comparison with a reference period (1991-2010).

It should be noted that according to the Synthesis Report of the 5th Assessment Report of the IPCC, the analysis of changes is proposed to be done at a level of 20 years. In this time horizon, the predicted changes in relation to the natural internal variability (i.e. more than two standard deviations of the internal variability in the period of 20 years) are achieved, while at the same time 90% of the models agree with the level of change.

<u>Geographic application and spatial analysis</u>

All data for the examined climate indices will be generated for a common grid of coordinates (latitude and longitude) and with the same spatial resolution (0.11º ~ 12.5 km, optimum resolution) for two CMIP5 (5th Coupled Model Intercomparison Project for the support of the 5th IPCC Assessment Report (AR5) for the scenarios: RCP4.5 and RCP8.5 until the year 2100.

The geographic coverage for the three pilot Oblast is presented in the following figures.

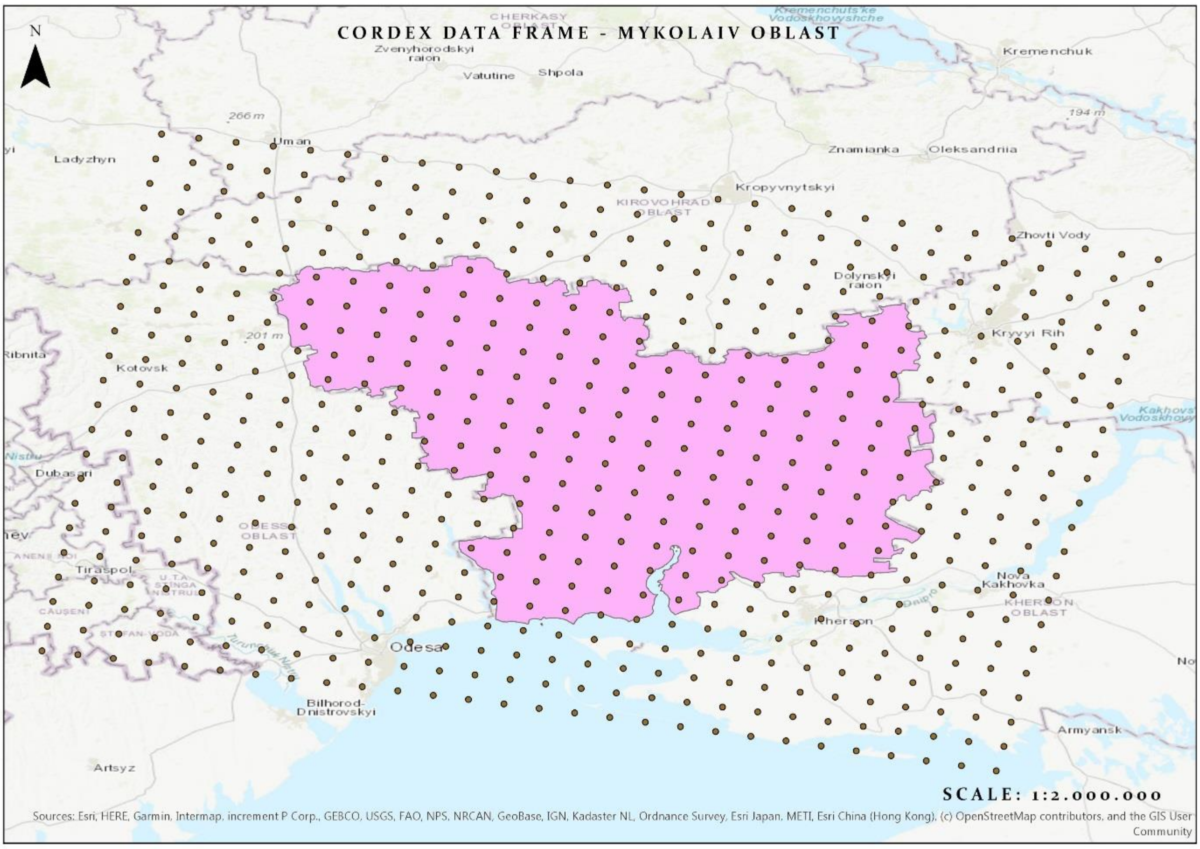

Figure 2: CORDEX Climate indices data frame for Mykolaivs’ka Oblast

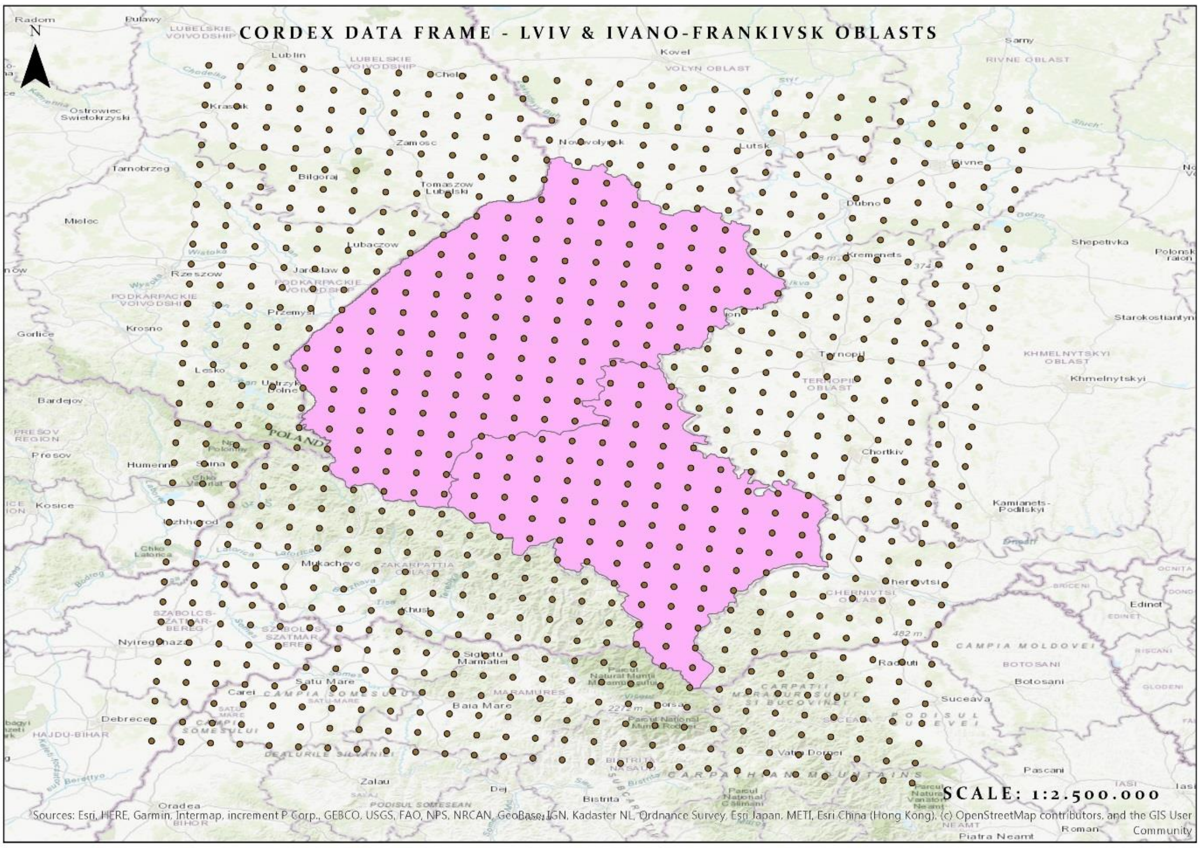

Figure 3: CORDEX Climate indices data frame for L'vivs'ka and Ivano-Frankivs'ka Oblasts

6.3 Utilization of Climate Indices to the Pilot Oblasts

The indices (main and supporting), which are proposed to be analyzed in the context of the three pilot Climate Change Adaptation Strategies, for the assessment of the future climate change and trends of extreme phenomena in the study areas, are presented in the following tables 3-5, and can be supplemented by others according to the specifics of climatic conditions and: climate change projections according to scenarios.