



LIFE URBANPROOF
CLIMATE PROOFING
URBAN MUNICIPALITIES



Guidelines for developing a Climate Action Plan for the Covenant of Mayors with the use of the Urbanproof toolkit

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PROJECT LIFE URBANPROOF (LIFE15 CCA/CY/000086)

Acknowledgments

The current Guide aims at supporting the municipalities that are signatories to the Covenant of Mayors in the development of their Climate Action Plans with the use of the UrbanProof toolkit. The UrbanProof toolkit was developed in the framework of the project LIFE UrbanProof (LIFE15 CCA/CY/000086) “Climate Proofing Urban Municipalities”, which is co-financed by the EC LIFE programme for the Environment and Climate Action.

The UrbanProof project is coordinated by the Ministry of Agriculture, Rural Development and Environment of Cyprus, while the UrbanProof toolkit has been developed by the National Technical University of Athens and the National Observatory of Athens (Greece).

Disclaimer: The Covenant of Mayors has not been involved in the preparation of this Guide and is not responsible for its content.

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1. Introduction






In the current document, a brief introduction is first being made with respect to the UrbanProof toolkit (Chapter 2). In Chapter 3, the compatibility of the methodology used in the UrbanProof toolkit to that proposed by the Urban Adaptation Support tool of the Covenant of Mayors and by the Guidebook of the Joint Research Center on the development of Climate Action Plans, is laid down. In Chapter 4 of the current document, detailed guidelines are provided on the use of the UrbanProof toolkit for conducting a Vulnerability and Risk Assessment for a given municipality, setting quantitative targets for the Climate Action Plan of the municipality and selecting adaptation actions for inclusion in the Climate Action Plan of the municipality.

2. About the UrbanProof toolkit

The URBANPROOF toolkit is a powerful decision support system aimed to enable better informed decision making for climate change adaptation planning. In specific, the user is guided through the different stages of the toolkit in order to gain insight into the climate change impacts to the urban environment, to explore and evaluate the available adaptation options and to investigate the effect of adaptation interventions in increasing climate change resilience.

The toolkit has been developed in the frame of the LIFE URBANPROOF project “Climate Proofing Urban Municipalities” which is co-financed by the LIFE programme for the Environment and Climate Action (2014-2020).

The UrbanProof toolkit consists of 5 interdependent stages which altogether comprise the adaptation process:

<p>STAGE 1: CLIMATE CHANGE INFORMATION.</p> 	<p>In Stage 1, the users may explore through interactive charts, information on climatic projections based on the greenhouse concentration levels of two Representative Concentration Pathways.</p>
<p>STAGE 2: IMPACT ASSESSMENT</p> 	<p>In Stage 2, the users may investigate through interactive GIS maps useful information with respect to selected climate change impact indicators relevant to the urban environment, as well as gain insight into the individual parameters (physical, structural & socio-economic) contributing to the creation of these impacts.</p>
<p>STAGE 3: EXPLORATION AND EVALUATION OF ADAPTATION OPTIONS</p> 	<p>In Stage 3, the users may explore information on the available adaptation measures and their evaluation against several criteria (MCA), while local stakeholders or experts may also evaluate the measures and set their own weights to the evaluation criteria.</p>
<p>STAGE 4: DEVELOPMENT OF THE ADAPTATION STRATEGY</p> 	<p>In Stage 4, the users may see the results of the prioritization of the evaluation that took place in Stage 3, and to select the ones that gathered the highest scoring for inclusion in the local climate action plan.</p>
<p>STAGE 5: MONITORING AND REVIEW</p> 	<p>In Stage 5, the users may investigate the effect of adaptation measures in reducing the expected impacts for the municipality. This is useful both for the targets setting phase and for the monitoring phase of the local adaptation plan.</p>

The UrbanProof toolkit provides information on the assessment of the following impact indicators for the urban municipalities of the three countries:



Competitive advantages of the UrbanProof toolkit:

- ✓ It allows for different geospatial information layers to be visualized and combined to present total impact assessment **results with sufficient spatial differentiation at municipal level**. The available resolution analysis (grid cells of 0.25km²) may provide relevant stakeholders with precise information with respect to where the highest impacts are expected and to guide adaptation.
- ✓ It presents information through **dynamic information layers**. In specific, the user may zoom at a specific location of the map within a municipality and see the exact value for a certain indicator by clicking at the map. In addition, the parallel comparison of two indicators or climate change scenarios is possible through a swipe layer function.
- ✓ It adopts the composite indicator approach in order to **capture the multi-dimensionality of impacts in a comprehensible form** and to support practical decision-making processes. One can always examine however the individual indicators in isolation.

The toolkit is available online at the following address <https://tool.urbanproof.eu/>.

For more information on the UrbanProof toolkit, one may also check the [User manual](#), the [Demonstration & tutorial video](#), as well as the [Background information](#) on the methods and sources used.

If you wish to use the UrbanProof toolkit for a municipality in one of the three UrbanProof countries, you may first check whether your municipality is included in the UrbanProof toolkit. One easy way to do this is provided through Stage 5 of the UrbanProof toolkit:

<https://tool.urbanproof.eu/editurbanproof/st5floods.php?lang=EN#>

In the top row, select country in the respective field and then find your municipality at the drop-down menu of the “Select municipality” field. If you find it, this means that the municipality is included in the UrbanProof toolkit.

Methodology

The impact assessment methodology applied in the UrbanProof toolkit is based on the relevant conceptual framework presented within the 5th Assessment Report (AR5) of the IPCC (2014)¹. In specific, impacts are considered to result from the interaction of hazard and vulnerability, while the latter is considered to be a function of the exposure, sensitivity and adaptive capacity of population and infrastructure.

Hazard indicators

- Relevant climatic information for each impact

Exposure indicators

- Exposure of population, land and/or critical infrastructure to an impact

Sensitivity indicators

- Population groups which are considered sensitive to climate change

Adaptive capacity indicators

- Capacity of the health care system and of the economy to address climate change impacts

The hazard indicators are assessed with the use of the outputs of Regional Climate Models on selected climatic parameters for the future, based on two Representative Concentration Pathways (RCP4.5, RCP8.5). The exposure indicators are based on information provided through several geospatial databases, such as the Global Human Settlement Layer of the Joint Research Centre and the databases of the Copernicus Land Monitoring Service. For the sensitivity and adaptive capacity indicators, the relevant economic and demographic data are sourced from Eurostat, as well as from the national statistical authorities of Italy, Greece and Cyprus.

Composite impact indicators are built in order to encompass the different factors contributing to the manifestation of each impact. A composite **Socio-economic vulnerability index** is also built for each municipality consisting of the following social and economic indicators:

- Share of very young and elderly people
- Illiteracy rate
- Share of population with chronic diseases
- Available hospital beds per capita
- Share of population at poverty risk
- Regional Gross Domestic Product

¹ IPCC 2014: Summary for policymakers. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1-32

The values of indicators expressed in different measurement units are normalized to a common scale, in order to be comparable. The socio-economic indicators are normalized based on their position with respect to the respective European average value (above/below average EU value).

3. UrbanProof compatibility with official tools and guidance

3.1 Urban Adaptation Support tool

The UrbanProof toolkit is built upon 5 stages which are considered to guide municipalities through the whole adaptation process. The UrbanProof toolkit process is in line with the Urban adaptation process indicated by the [Urban Adaptation Support Tool](#) of the Covenant of Mayors –Europe Office and the European Environment Agency. See for example Stage 1-5 of the UrbanProof toolkit and Steps 2-6 of the Urban Adaptation Support Tool, in the following figure.



3.2 Guidebook on the development of SECAP

The UrbanProof toolkit is also consistent with the **JRC Guidebook 'How to develop a Sustainable Energy and Climate Action Plan (SECAP), part 1 and 2'** (Bertodi et al., 2018)². In particular, the UrbanProof toolkit methodology for elaborating a Climate action plan is fully in line with the respective guidance provided in Part

² Bertodi P. (editor), *Guidebook 'How to develop a Sustainable Energy and Climate Action Plan (SECAP) – Part 1 - The SECAP process, step-by-step towards low carbon and climate resilient cities by 2030*, EUR 29412 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-96847-1

Bertodi P. (editor), *Guidebook 'How to develop a Sustainable Energy and Climate Action Plan (SECAP) – Part 2 - Baseline Emission Inventory (BEI) and Risk and Vulnerability Assessment (RVA)*, EUR 29412 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-96929-4

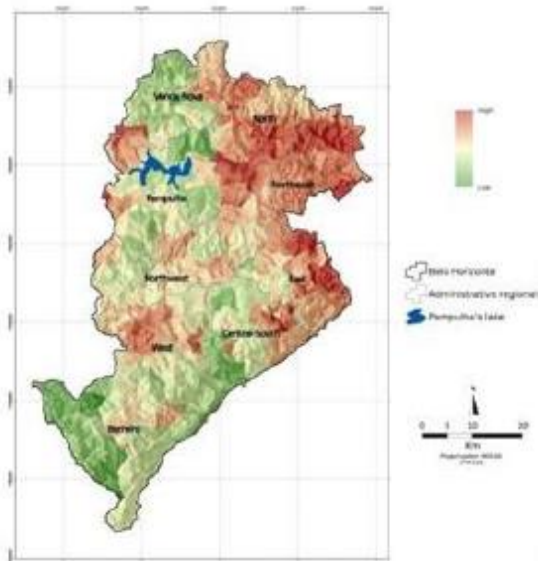
1 of the JRC Guidebook. In addition, the UrbanProof toolkit is also in line with the methodological approach suggested by the JRC Guidebook – Part 2, for conducting a Risk and Vulnerability Assessment (RVA) for a SECAP.

3.2.1 Risk and Vulnerability Assessment methodology

In particular, the Guidebook (part 2) proposes two methodological approaches for conducting an RVA, which differ in the level of detail, required data, tools and technical skills needed to calculate the vulnerability to a specific hazard.

- The **Spatially explicit approach** which relies on climate impact-models to produce hazard maps according to specific climate stressor and city biophysical attributes. Using spatially-explicit modelling demands technical skills and robust georeferenced datasets, not always available in small and mid-size cities. Therefore, it is most suited for greater local authorities that usually have the necessary resources and capacities to use the models and act on the main outcomes.
- The **Indicator-based assessment** helps users to identify the factors that shape city vulnerability to climate threats through comparable composite indicators. This approach is particularly suitable for smaller and mid-size cities since it doesn't demand particularly technical skills or modelling tools and can be fed by using public available datasets.

MAP OF RISK TO FLOOD



Spatially explicit approach

INDEX OF VULNERABILITY TO FLOOD



Indicator-based vulnerability assessment

Figure 1: Examples of the two methodological approaches for RVA proposed in Bertodi et al. (2018)

The UrbanProof toolkit is developed based on the Spatially explicit approach, thus providing highly detailed information for small and medium sized urban municipalities as well, without demanding particularly technical skills or tools, as all the required work has been already carried out for all urban municipalities and is available in a comprehensible form through the UrbanProof toolkit.

Following, the steps for conducting an RVA based on the Spatially explicit approach according to Bertodi et al. (2018) are presented, while next to each step the respective UrbanProof toolkit approach is laid down.

The output of the Risk and Vulnerability assessment carried out in the UrbanProof toolkit is presented in [Stage 2](#) of the toolkit. Section 4.1 of the current document provides guidance on how to use the UrbanProof toolkit for this purpose.

Table 1: Spatially explicit approach for conducting an RVA based on Bertodi et al. (2018) and the respective UrbanProof toolkit approach

Steps	Description of the approach in the JRC Guidebook	The UrbanProof toolkit approach
STEP 1: Exploratory analysis with key-stakeholders	Meeting with city stakeholders in order to contextualize the study, understand needs and expectations, identify climate change impacts, explain the RVA approach and the required data	Not covered.
STEP 2: Downscale global climate data to regional context	Downscaling the results of global climate models (GCMs) to high resolution in order to capture the spatial and temporal variability of projected changes in climate at a sound scale for urban RVA.	The outputs of the MPI-ESM-LRRCA4 RCA6 Regional Climate Model were used for the calculation of climatic hazard indicators.
STEP 3: Climate-impact modelling - linking system attributes to climate projections	Use of GIS-based tools to link climatic hazard indicators to biophysical and socioeconomic data. The model output comes in the form of maps representing – for a specific time window and climate scenario – the spatial variability within the urban perimeter of the potential impacts	The geospatial climatic hazard information was linked to other biophysical indicators and socio-economic pathways to produce different maps for the reference and future periods (1971-2000, 2030-2060) for two emission scenarios (RCP4.5, RCP4.8)
STEP 4: Map city vulnerabilities	Each hazard affects different areas within a city, and the consequences depend on specific socioeconomic and institutional weaknesses relevant to the impact at stake.	Development of the Social Vulnerability Index for each municipality, comprising of several socio-economic indicators relevant to the examined impacts
STEP 5: Define Exposure by mapping important assets within the city	Information about the location and properties of relevant city assets, such as buildings, roads, historical monuments, and population density, has to be included into an assets inventory map. This map represents the exposure of the system.	Critical infrastructure (hospitals, schools, cultural monuments, industrial/commercial units, airports/ports, road/rail network) and population density are included in relevant maps
STEP 6: Overlay hazard, vulnerability and asset maps (exposure) to assess the number of assets at risk	The hazard map is combined with the vulnerability map and the assets map (exposure) to quantify the number of assets and vulnerable communities at risk. All the explanatory variables of risk are geo-referenced and normalized to become spatially comparable and aggregable in a weighted index. Finally, the urban risk map is computed by integrating its determinants - i.e. hazard, vulnerability and exposure.	Creation of composite impact indicator maps through the integrated assessment of hazard, vulnerability and exposure indicators by applying the appropriate normalization, weighting and aggregation methods.
STEP 7: Assess the risk (potential loss and damage)	Assess unit damage costs and damage functions for each asset	Not covered.

3.2.2 Development of the Climate Action Plan

The JRC Guidebook – Part 1 (Bertodi et al. 2018)² suggests that before the development of a Climate Action Plan, municipalities should establish a long-term vision with clear objectives and targets (Chapter 7). The UrbanProof toolkit may support municipalities in this task through Stage 5.

In specific, in Stage 5 of the UrbanProof toolkit, one may explore the potential of the implementation of adaptation measures in increasing the resilience for the municipality towards a climate change impact. Therefore, municipalities may use this Stage to set quantitative targets for reduction of the level of the expected impacts locally, as well as at a wider municipality level, with a set of adaptation actions. Section 4.2 of the current document provides guidance on how to use the UrbanProof toolkit for this purpose.

Furthermore, in Chapter 8 of the JRC Guidebook – Part 1 (Bertodi et al. 2018)² a list of recommended steps for drafting a successful SECAP is provided as shown below:

- i. **Make a prospective of good practices**
- ii. **Set priorities and select key actions / measures**
- iii. Carry out a risk analysis
- iv. Specify timing, clear responsibilities, budget and financing sources of each action
- v. Draft the Action Plan
- vi. Approve the Action Plan and its associated budget
- vii. **Perform regular SECAP reviews**

The UrbanProof toolkit may support municipalities in carrying out the tasks highlighted in bold above, as further explained in the table that follows. Section 4.3 of the current document provides guidance on how to use the UrbanProof toolkit for this purpose.

Table 2: Proposed methodology for selecting adaptation measures according to Bertodi et al. (2018) and the respective UrbanProof toolkit approach

Proposed methodology in the JRC Guidebook	The UrbanProof toolkit approach
<ul style="list-style-type: none"> ○ Make a prospective of good practices ○ Set priorities and select key actions / measures: <ul style="list-style-type: none"> ○ Conduct a preliminary analysis of the possible actions: what are the costs and benefits of each of them. ○ Rank the possible measures by importance in a table summarising the main characteristics of each action: duration, level of required resources, expected results, associated risks, etc. ○ Define which criteria you want to consider for the selection of measures (investment required, energy savings, reduction of climate impacts and related costs, cross-cutting and infra-sectoral benefits, employment growth, improved air quality, relevance to the overall objectives of the local authority, political and social acceptability, timeframe, payback, iK) ○ Decide which weight you give to each criterion. ○ Evaluate each criterion, measure by measure, in order to obtain a "score" for each measure 	<ul style="list-style-type: none"> ○ In Stage 3 of the UrbanProof toolkit, there is a list of adaptation measures for addressing the examined climate change impacts. For each of these measures, information is provided with respect to their philosophy, the expected results and the associated costs ○ A Multi Criteria Analysis application is built for prioritizing adaptation measures based on their evaluation against a set of criteria: efficiency in addressing the impact, environmental friendliness, economic viability, employment growth ○ The users may assign weights to the criteria and evaluate the adaptation measures against each criterion according to their perception of their relevant importance in the evaluation of the adaptation measures. Alternatively, they may use the evaluation provided by a pool of experts. ○ Then in Stage 4 of the UrbanProof toolkit, the adaptation measures are prioritized based on the score they obtained from the MCA evaluation in Stage 3. ○ The measures gathering the higher ratings may be included in the Local Adaptation Plan of the municipality.
<ul style="list-style-type: none"> ○ Perform regular SECAP reviews 	<ul style="list-style-type: none"> ○ Stage 5 of the UrbanProof toolkit may be used to track the progress achieved towards the initially foreseen targets and revise if necessary

4. Guidance on the use of the UrbanProof toolkit

This section provides guidance on how to incorporate the outputs of the UrbanProof toolkit in the development of a Climate Action Plan for a municipality in the framework of the Covenant of Mayors. The guidance is in accordance with the Reporting guidelines of the EU Covenant of Mayors (2020)³. In particular the guidance provided refers to the following steps of the development of a Climate Action Plan:

- ❖ Conducting a Risk and Vulnerability assessment with the use of Stage 2 of the UrbanProof toolkit
- ❖ Setting quantitative targets for the Climate Action Plan of the municipality with the use of Stage 5 of the UrbanProof toolkit
- ❖ Identification, assessment and selection of adaptation actions with the use of Stages 3 and 4 of the UrbanProof toolkit

It is highlighted that the use of the UrbanProof toolkit is open and accessible to everyone without any charge. However, it is highly desirable that if you use the UrbanProof toolkit for the development of a Climate Action Plan, you provide the appropriate acknowledgements in the text. You are also welcome to inform us by email at lifurbanproof@gmail.com with respect to the specific municipality for which the toolkit will be/was used (for statistical purposes). Furthermore, you may always contact us at the same email, should you wish any support on the use of the UrbanProof toolkit.

³ CoM, 2020. Reporting Guidelines. Covenant of Mayors for Climate and Energy Europe

4.2 Stage 2: Risk and Vulnerability Assessment

The Climate Action Plan is based on a Risk & Vulnerability Assessment (RVA) which provides an analysis of the current situation. To incorporate the RVA output of the UrbanProof toolkit (Stage 2) for a given municipality in the respective section of the SECAP and in the reporting platform of the Covenant of Mayors, one may follow the steps below.

In the MyCovenant section of the Covenant reporting platform, select Reporting corner → My inventories → Risks and Vulnerabilities. This section is built upon the following structure:

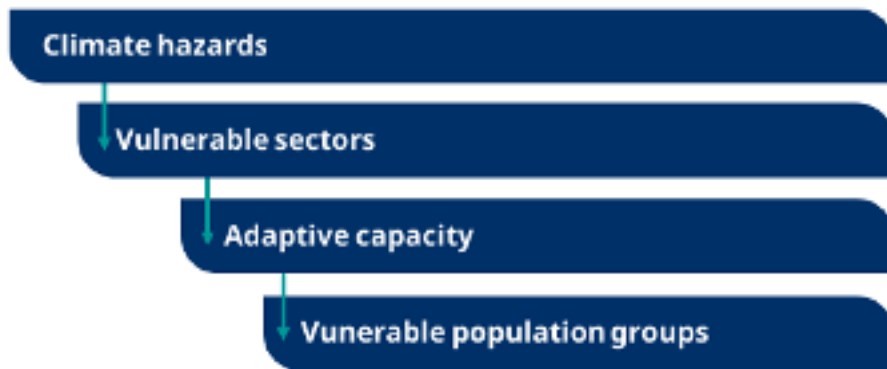


Figure 2: Structure of the Risk and vulnerabilities section, Covenant reporting platform

For each of the above elements, there is one table that must be filled. To fill the tables with the information provided through the UrbanProof toolkit, follow the guidance provided below.

Table 1) Climate hazards

In Table 1, you may use the information provided in [Stage 2 the UrbanProof toolkit](#) on the assessment of climate hazards related to extreme heat, floods and wild fires. For detailed guidance on the use of Stage 2, one may also consult the [User manual](#)⁴.

I. Climate hazard: Extreme heat

There are two impact indicators in the UrbanProof toolkit associated to the climate hazard “Extreme heat”. The first refers to the impact of extreme heat on human health, i.e. the HUMIDEX indicator, and the second refers to the impact of high temperature in the electricity demand for cooling, i.e. the indicator Cooling Degree days (CDD). In specific, HUMIDEX is a climatic indicator reflecting the impacts of temperature and humidity on human discomfort. CDD reflects the demand for energy needed to cool a building.

Climate hazards	<< Current risk of hazard occurring >>		<< Future hazards >>		
	Probability of hazard	Impact of hazard	Expected change in hazard intensity	Expected change in hazard frequency	Timeframe(s)
<input checked="" type="checkbox"/> Other	(please specify)	(Please choose)	(Please choose)	(Please choose)	(Please choose)

a. Extreme heat and Health

To start with, one should tick the box next to the Climate hazard “Others” which is located at the last row of Table 1, and type in the first column “Extreme heat and Health”.

Current risk of hazard occurring

Column “Probability of hazard”: Select “Not known”

Column “Impact of hazard”: To examine the level of the current impact of the hazard for the municipality follow the steps indicated next.

- **Step 1:** Go to UP Stage 2 (all urban municipalities)
- **Step 2:** At the field “Zoom to...” located at the top left side part of the map, select country and then with the Zoom in button located next to it, click at the map to locate the municipality which you are interested to examine.

⁴ https://tool.urbanproof.eu/wp-content/uploads/2021/02/UrbanProofManualEN_02_2021.pdf

- **Step 3:** At the top of the left panel, select “Baseline scenario (1971-2000)” at the Climate change scenario field.
- **Step 4:** Tick the box of the layer in the left panel “Mean Summer HUMIDEX” located in the folder path *Impact assessment>Heatwaves and health>Relevant climatic information*
- **Step 5:** Copy-paste the produced map in Section Risks and Vulnerabilities assessment of your SECAP together with the relevant legend which is located at the bottom of the left panel, as shown in the example below. Then estimate average impact level for the municipality.
- **Step 6:** Open the drop-down list in the respective cell of the Column “Impact of hazard” and select the most relevant option.



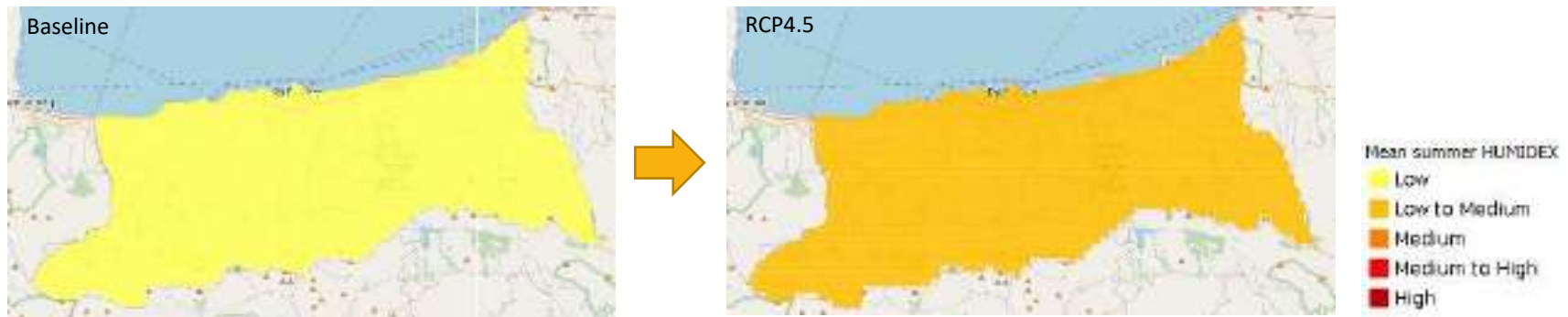
Future hazards

Column “Expected change in hazard intensity”: To examine the expected change in hazard intensity for the municipality, follow Steps 3-6 as indicated next (Steps 1 and 2 have already been applied).

- **Step 3:** Select a future Climate change scenario at the top of the left panel, i.e. among the RCP4.5 scenario (stabilization of GHG levels) and the RCP8.5 scenario (increasing GHG levels) for 2031-2060.
- **Step 4:** Tick the box of the layer in the left panel “Mean Summer HUMIDEX” located in the folder path *Impact assessment> Heatwaves and health >Relevant information*
- **Step 5:** Copy the produced map of the municipality and paste it in Section Risks and Vulnerabilities assessment of your SECAP together with the relevant legend. Then compare with the respective map produced for the current impact of hazard and estimate the expected change in hazard intensity for the municipality⁵.

⁵ To compare 2 different maps, one may also use the Compare tool of the UrbanProof toolkit (swipe layers), located at the toolbox above the map in Stage 2

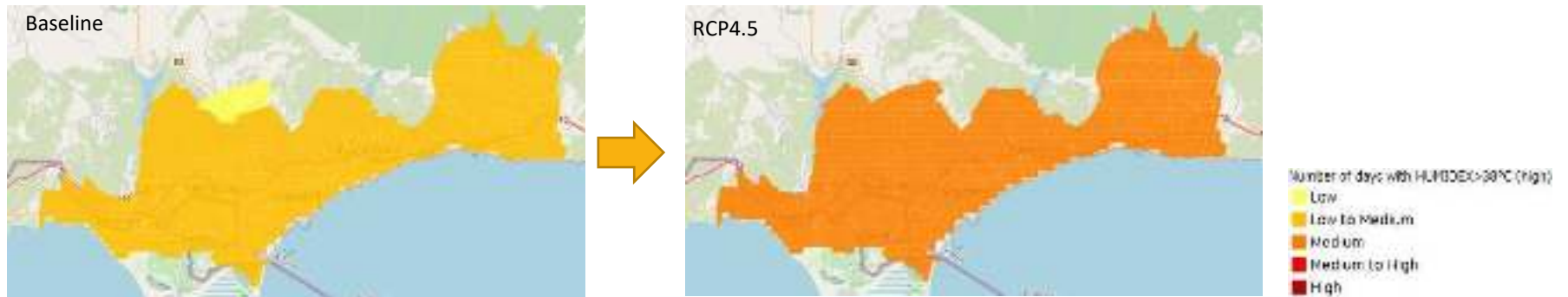
- **Step 6:** Open the drop-down list in the field “Expected change in hazard intensity” and select the most relevant option.



Column “Expected change in hazard frequency”: To examine the expected change in hazard frequency for the municipality, follow Steps 3-7 as indicated next (Steps 1 and 2 have already been applied).

- **Step 3:** At the top of the left panel, select “Baseline scenario (1971-2000)” at the Climate change scenario field.
- **Step 4:** Tick the box of the layer in the left panel “Number of days with HUMIDEX>38°C (high discomfort)” located in the folder path *Impact assessment>Heatwaves and health >Relevant climatic information*
- **Step 5:** Copy the produced map of the municipality and paste it in Section “Risks and Vulnerabilities assessment” of your SECAP together with the relevant legend.
- **Step 6:** Select a future Climate change scenario at the top of the left panel, i.e. among the RCP4.5 scenario (stabilization of GHG levels) and the RCP8.5 scenario (increasing GHG levels) for 2031-2060.
- **Step 7:** Copy the produced map of the municipality and paste it in Section Risks and Vulnerabilities assessment of your SECAP, next to the map of Step 5. Then compare maps and estimate the expected change in hazard frequency for the municipality.
- **Step 8:** Open the drop-down list in the respective cell of the Column “Expected change in hazard frequency” and select the most relevant option.

Column “Timeframe”: Open the drop-down list and select “Mid-term”.



b. Electricity demand for cooling

To start with, one should tick the box next to the Climate hazard “Others” which is located at the last row of Table 1, and type in the first column “Electricity demand for cooling”.

Current risk of hazard occurring

Column “Probability of hazard”: Select “Not known”

Column “Impact of hazard”: To examine the level of the current impact of the hazard for the municipality follow the steps indicated next.

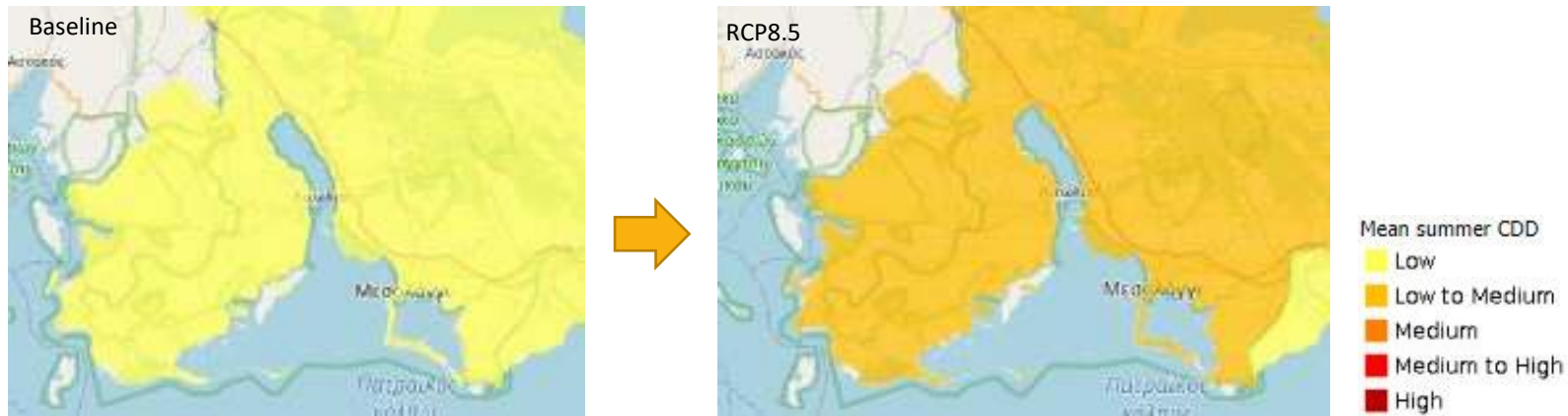
- **Step 1:** Go to UP Stage 2 (all urban municipalities)
- **Step 2:** At the field “Zoom to...” located at the top left side part of the map, select country and then with the Zoom in button located next to it, click at the map to locate the municipality which you are interested to examine.
- **Step 3:** At the top of the left panel, select “Baseline scenario (1971-2000)” at the Climate change scenario field.
- **Step 4:** Tick the box of the layer in the left panel “Mean Summer CDD” located in the folder path *Impact assessment > Electricity demand for cooling > Relevant climatic information*
- **Step 5:** Copy-paste the produced map in Section Risks and Vulnerabilities assessment of your SECAP together with the relevant legend which may be found at the bottom of the left panel, as shown in the example below. Then estimate average impact level for the municipality (in the example, Low).
- **Step 6:** Open the drop-down list in the respective cell of the Column “Impact of hazard” and select the most relevant option.



Future hazards

Column “Expected change in hazard intensity”: To examine the expected change in hazard intensity for the municipality, follow Steps 3-6 as indicated next (Steps 1 and 2 have already been applied).

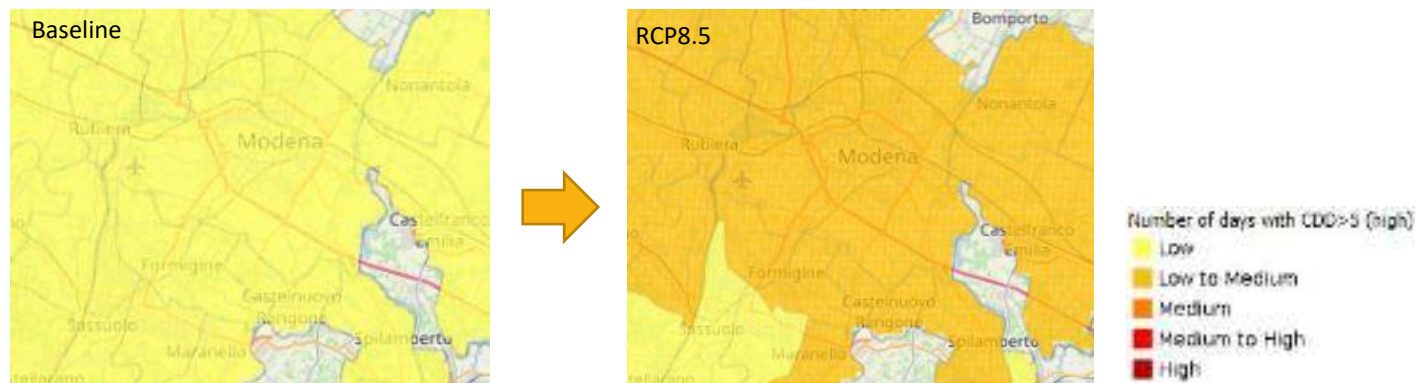
- **Step 3:** Select a future Climate change scenario at the top of the left panel, i.e. among the RCP4.5 scenario (stabilization of GHG levels) and the RCP8.5 scenario (increasing GHG levels) for 2031-2060.
- **Step 4:** Tick the box of the layer in the left panel “Mean Summer CDD” located in the folder path *Impact assessment > Electricity demand for cooling > Relevant information*
- **Step 5:** Copy the produced map of the municipality and paste it in Section Risks and Vulnerabilities assessment of your SECAP together with the relevant legend. Then compare with the respective map produced for the current impact of hazard and estimate the expected change in hazard intensity for the municipality⁵.
- **Step 6:** Open the drop-down list in the field “Expected change in hazard intensity” and select the most relevant option.



Column “Expected change in hazard frequency”: To examine the expected change in hazard frequency for the municipality, follow Steps 3-7 as indicated next (Steps 1 and 2 have already been applied).

- **Step 3:** At the top of the left panel, select “Baseline scenario (1971-2000)” at the Climate change scenario field.
- **Step 4:** Tick the box of the layer in the left panel “Number of days with CDD>5 (high electricity demand)” located in the folder path *Impact assessment> Electricity demand for cooling>Relevant climatic information*
- **Step 5:** Copy the produced map of the municipality and paste it in Section “Risks and Vulnerabilities assessment” of your SECAP together with the relevant legend.
- **Step 6:** Select a future Climate change scenario at the top of the left panel, i.e. among the RCP4.5 scenario (stabilization of GHG levels) and the RCP8.5 scenario (increasing GHG levels) for 2031-2060.
- **Step 7:** Copy the produced map of the municipality and paste it in Section Risks and Vulnerabilities assessment of your SECAP, next to the map of Step 5. Then compare maps and estimate the expected change in hazard frequency for the municipality.
- **Step 8:** Open the drop-down list in the respective cell of the Column “Expected change in hazard frequency” and select the most relevant option.

Column “Timeframe”: Open the drop-down list and select “Mid-term”.



II. Climate hazard: Floods

For the assessment of the current risk of flood hazard occurring in the UrbanProof toolkit, the flood hazard maps produced by the competent national authorities in compliance with the Floods Directive 2007/60/EC (source: Eionet Reporting Obligations Database, European Environment Agency) were used for identifying the location and extent of the area potentially affected by flooding (flood hazard zone). A 100-year flood return period was selected over other higher flood recurrence periods (e.g. 10-year return period), in order to take into account of the maximum area potentially affected by floods.

Climate hazards	<< Current risk of hazard occurring >>		<< Future hazards >>		
	Probability of hazard	Impact of hazard	Expected change in hazard intensity	Expected change in hazard frequency	Time frame(s)
<input checked="" type="checkbox"/> Floods & sea level rise	[Please choose]	Medium	[Please choose]	[Please choose]	Not known

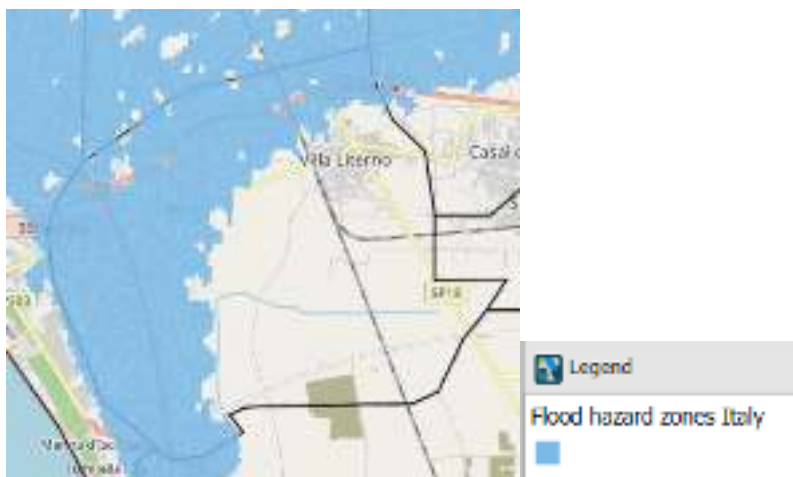
Current risk of hazard occurring

Column “Probability of hazard”: Select “Low”

Column “Impact of hazard”: To examine the level of the current impact of the flood hazard for the municipality follow the steps indicated next.

- Step 1: Go to UP Stage 2 (all urban municipalities)

- Step 2: At the field “Zoom to...” located at the top left side part of the map, select country and then with the Zoom in button located next to it, click at the map to locate the municipality which you are interested to examine.
- Step 3: At the top of the left panel, select “Baseline scenario (1971-2000)” at the Climate change scenario field.
- Step 4: Tick the box of the layer in the left panel “Flood hazard zones” located in the folder path *Impact assessment>Floods>Relevant information*
- Step 5: Copy-paste the produced map in Section Risks and Vulnerabilities assessment of your SECAP together with the relevant legend, as shown in the example below. Then, estimate the impact level for the municipality based on the share of the municipality area covered by the flood hazard zone.
- Step 6: Open the drop-down list in the respective cell of the Column “Impact of hazard” and select the most relevant option.



Future hazards

For the assessment of future flood hazard in the UrbanProof toolkit, an investigation of the trends in relevant climatic indicators took place, such as the change in the projected maximum precipitation within one day and five days and the change in the projected number of heavy and very heavy precipitation days, on an annual basis. However, the investigation revealed no statistical significant trends during the examined future periods under both future emission scenarios, RCP4.5 and RCP8.5. Therefore, in the relevant fields where the expected change in hazard intensity and frequency is assessed, one may select “No change”. Alternatively, one may use the indicator “Projected change in winter heavy precipitation” provided through the Urban Adaptation Map Viewer (European Environment Agency) for assessing the change in hazard intensity and the indicator “Relative change in average

frequency of peak flow events” presented in Alfieri et al. (2015) for assessing the change in hazard frequency (data are only available for Greece and Italy, but not for Cyprus).

Column “Expected change in hazard intensity”: To examine the expected change in hazard intensity for the municipality, follow the steps indicated next.

- **Step 1:** Go to the website of the Urban Adaptation Map Viewer ([link](#)) and select the tab “Pluvial floods” at the top menu.
- **Step 2:** At the field “Search location” located at the top of the map, type the name of the municipality which you are interested to examine.
- **Step 3:** Copy the produced map of the municipality with respect to the indicator “Projected change in heavy precipitation in winter, %) and paste it in Section Risks and Vulnerabilities assessment of your SECAP, together with the relevant legend. Then, estimate the expected change in hazard intensity for the municipality⁵.
- **Step 4:** Open the drop-down list in the respective cell of Column “Expected change in hazard intensity” and select the most relevant option.

Column “Expected change in hazard frequency”: To examine the expected change in hazard frequency for the municipality, follow the steps indicated next.

- **Step 1:** Go to the online publication of Alfieri et al. (2015)⁶ ([link](#)) and open Figure 7: Average frequency of peak flow events with return periods larger than 2 years, baseline and relative change.
- **Step 2:** Copy any of the two maps at the bottom (2050vs1990>Mid-term timeframe, 2080vs1990>Long-term timeframe) and paste it in Section “Risks and Vulnerabilities assessment” of your SECAP together with the relevant legend. Then estimate the expected change in hazard frequency in the wider area where the municipality is located.
- **Step 3:** Open the drop-down list in the respective cell of the Column “Expected change in hazard frequency” and select the most relevant option.

Column “Timeframe”: Open the drop-down list and select “Long-term” or “Mid-Term” based on your selection in Step 2.

III. Climate hazard: Wild fires

For the assessment of the Climate hazard Wild fires, the Fire Weather Index (FWI) may be used. FWI is a meteorologically-based index used to estimate fire danger based on temperature, relative humidity, wind speed and precipitation. To start with, tick the box next to the Climate hazard Wild fires.

⁶ Alfieri L, Burek P, Feyen L, Forzieri G. Global warming increases the frequency of river floods in Europe. *HYDROLOGY AND EARTH SYSTEM SCIENCES* 19 (5); 2015. p. 2247– 2260. JRC94407

Forest fire/Land fire: If there is forested land in your municipality, fill the fields for forest fire and land fire, otherwise fill only the fields for the latter.

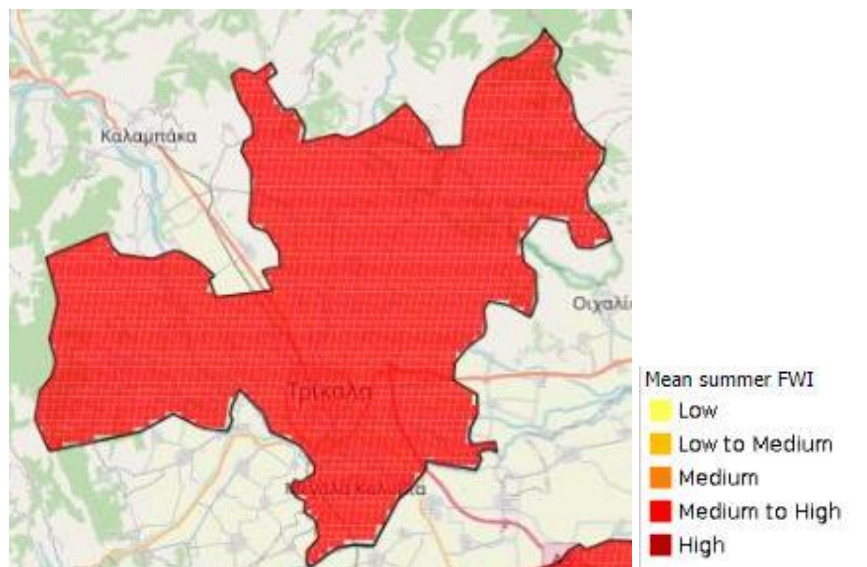
Climate hazards	<< Current risk of hazard occurring >>		<< Future hazards >>		
	Probability of hazard	Impact of hazard	Expected change in hazard intensity	Expected change in hazard frequency	Timeframe(s)
<input type="checkbox"/> Wild fires	[Please choose]	[Please choose]	[Please choose]	[Please choose]	[Please choose]
<input type="checkbox"/> Lined fire	[Please choose]	[Please choose]	[Please choose]	[Please choose]	[Please choose]
<input type="checkbox"/> Land fire	[Please choose]	[Please choose]	[Please choose]	[Please choose]	[Please choose]

Current risk of hazard occurring

Column “Probability of hazard”: Select “Not known”

Column “Impact of hazard”: To examine the level of the current impact of the hazard for the municipality follow the steps indicated next.

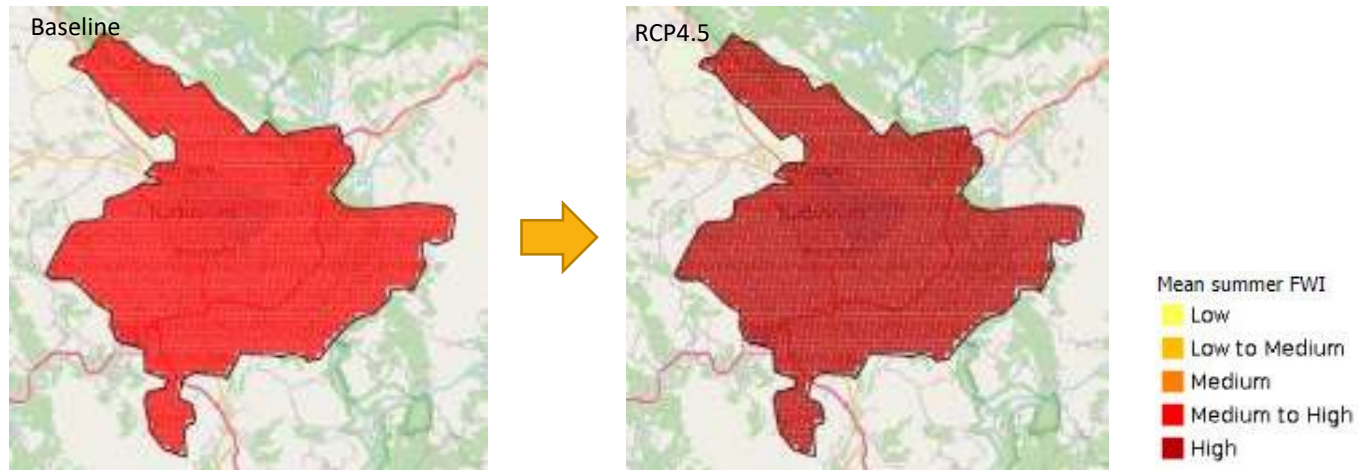
- **Step 1:** Go to UP Stage 2 (all urban municipalities)
- **Step 2:** At the field “Zoom to...” located at the top left side part of the map, select country and then with the Zoom in button located next to it, click at the map to locate the municipality which you are interested to examine.
- **Step 3:** At the top of the left panel, select “Baseline scenario (1971-2000)” at the Climate change scenario field.
- **Step 4:** Tick the box of the layer in the left panel “Mean Summer FWI” located in the folder path *Impact assessment>Peri-urban fires>Relevant information*
- **Step 5:** Copy-paste the produced map in Section Risks and Vulnerabilities assessment of your SECAP together with the relevant legend, as shown in the example below. Then estimate average impact level for the municipality (in the example, Medium).
- **Step 6:** Open the drop-down list in the respective cell of the Column “Impact of hazard” and select the most relevant option (in the example, Moderate).



Future hazards

Column “Expected change in hazard intensity”: To examine the expected change in hazard intensity for the municipality, follow Steps 3-6 as indicated next (Steps 1 and 2 have already been applied).

- **Step 3:** Select a future Climate change scenario at the top of the left panel, i.e. among the RCP4.5 scenario (stabilization of GHG levels) and the RCP8.5 scenario (increasing GHG levels) for 2031-2060.
- **Step 4:** Tick the box of the layer in the left panel “Mean Summer FWI” located in the folder path *Impact assessment>Peri-urban fires>Relevant information*
- **Step 5:** Copy the produced map of the municipality and paste it in Section Risks and Vulnerabilities assessment of your SECAP together with the relevant legend. Then compare with the respective map produced for the current impact of hazard and estimate the expected change in hazard intensity for the municipality⁵.
- **Step 6:** Open the drop-down list in the respective cell of Column “Expected change in hazard intensity” and select the most relevant option.



Column “Expected change in hazard frequency”: To examine the expected change in hazard frequency for the municipality, follow Steps 3-7 as indicated next (Steps 1 and 2 have already been applied).

- **Step 3:** At the top of the left panel, select “Baseline scenario (1971-2000)” at the Climate change scenario field.
- **Step 4:** Tick the box of the layer in the left panel “Number of days with Fire Weather Index>30 (high fire risk)” located in the folder path *Impact assessment>Peri-urban fires>Relevant information*
- **Step 5:** Copy the produced map of the municipality and paste it in Section “Risks and Vulnerabilities assessment” of your SECAP together with the relevant legend.
- **Step 6:** Select a future Climate change scenario at the top of the left panel, i.e. among the RCP4.5 scenario (stabilization of GHG levels) and the RCP8.5 scenario (increasing GHG levels) for 2031-2060.
- **Step 7:** Copy the produced map of the municipality and paste it in Section Risks and Vulnerabilities assessment of your SECAP, next to the map of Step 5. Then compare maps and estimate the expected change in hazard frequency for the municipality.
- **Step 8:** Open the drop-down list in the respective cell of the Column “Expected change in hazard frequency” and select the most relevant option.

Column “Timeframe”: Open the drop-down list and select “Mid-term”.

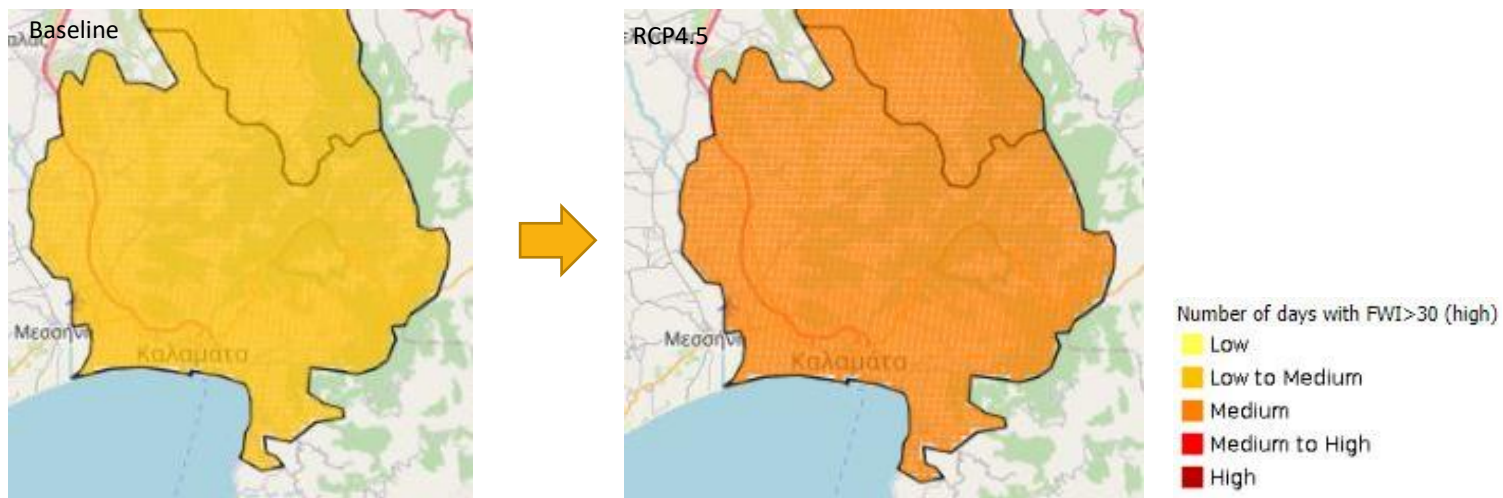


Table 2) Vulnerable sectors

In Table 2, you may use the relevant information provided in the UrbanProof toolkit for assessing the Current vulnerability level of the sectors impacted by the identified climate hazards in Table 1.

I. Climate hazard: Extreme heat and health

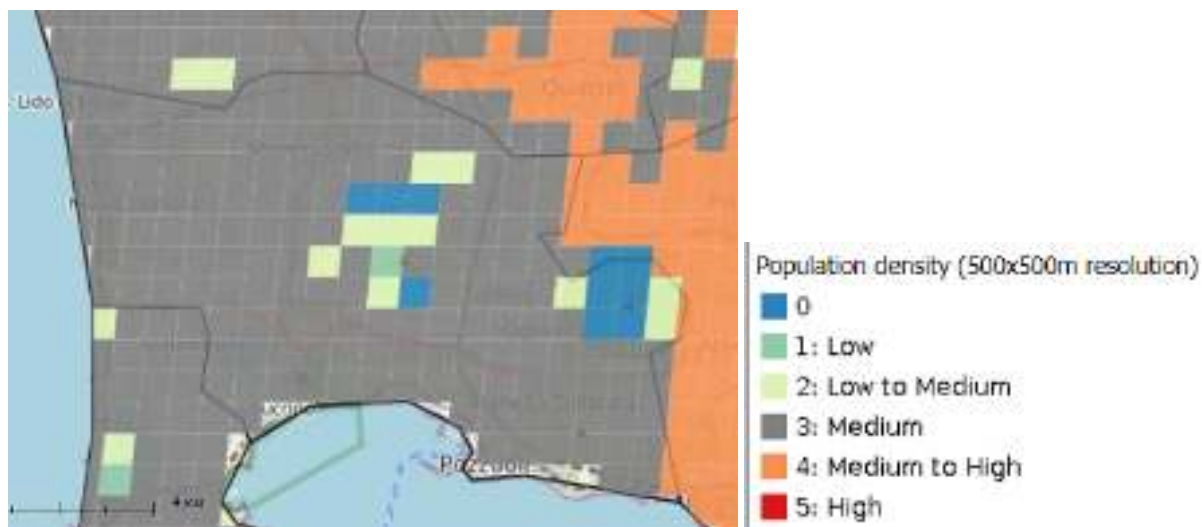
In the field next to the “Climate hazard” Extreme heat and health, choose as “Relevant vulnerable sector(s)” the following: Health. The available indicator of the UrbanProof toolkit that may be used for assessing the vulnerability of Health to Extreme heat, is the following: Population density in areas with high human discomfort.

	Climate hazards	Relevant vulnerable sector(s)	Current vulnerability level	Indicator
<input checked="" type="checkbox"/>	Extreme heat	Health	[Please choose]	[Choose from Annex 3 or write down your own]

Health sector

To explore information on this indicator, follow Steps 3-9 as indicated next (Steps 1 and 2 have already been applied).

- **Step 3:** Tick the box next to the indicator Population density in the left panel of Stage 2, located in the folder path *Impact assessment>Other relevant indicators>Population density*
- **Step 4:** Copy the produced map of the municipality and paste it in Section Risks and Vulnerabilities assessment of your SECAP together with the relevant legend



- **Step 5:** At the top of the left panel, select “Baseline scenario (1971-2000)” at the Climate change scenario field.
- **Step 6:** Tick the box of the layer in the left panel “Mean Summer HUMIDEX” located in the folder path *Impact assessment>Heatwaves and health>Relevant climatic information*
- **Step 7:** Copy the produced map of the municipality and paste it in Section Risks and Vulnerabilities assessment of your SECAP together with the relevant legend, next to the map of Step 4. Then compare maps and estimate the Population density in the areas with high Mean Summer Humidex.
- **Step 8:** Open the drop-down list in the cell of Column “Current vulnerability level” and select the option that best reflects the assessed vulnerability level of the indicator.
- **Step 9:** In the last column “Indicator”, write down the indicators you have used for the vulnerability assessment.

II. Climate hazard: Electricity demand for cooling

In the field next to the Climate hazard Electricity demand for cooling, choose as Relevant vulnerable sector the following: Energy.

The available indicator of the UrbanProof toolkit that may be used for assessing the vulnerability level of the Energy sector against Electricity demand for cooling, is the following: Population density.

To explore information on this indicator, follow Steps 3-6 as indicated next (Steps 1 and 2 have already been applied).

- Step 3: Tick the box next to the respective indicator in the left panel of Stage 2, located in the folder path *Impact assessment>Other relevant indicators>Population density*
- Step 4: Copy the produced map of the municipality and paste it in Section Risks and Vulnerabilities assessment of your SECAP together with the relevant legend and examine the vulnerability level of the indicator for the municipality.
- Step 5: Open the drop-down list in the cell of Column “Current vulnerability level” and select the option that best reflects the assessed vulnerability level of the indicator.
- Step 6: In the last column “Indicator”, write down the indicator you have used for the vulnerability assessment.

III. Climate hazard: Floods

In the field next to the Climate hazard Floods, choose as Relevant vulnerable sectors the following: Health, Buildings.

Health sector

The available indicator of the UrbanProof toolkit that may be used for assessing the vulnerability level of Health to Floods, is the following: Population density at flood hazard zone.

To explore information on this indicator, follow Steps 3-7 as indicated next (Steps 1 and 2 have already been applied).

- Step 3: Tick the box next to the Population density indicator in the left panel of Stage 2, located in the folder path *Impact assessment>Other relevant indicators>Population density*
- Step 4: Tick the box next to the Flood hazard zone layer located in the folder path *Impact assessment>Floods>Relevant information*, to generate information on the population density at flood hazard zone
- Step 4: Copy the produced map of the municipality and paste it in Section Risks and Vulnerabilities assessment of your SECAP together with the relevant legend and examine the vulnerability level of the indicator for the municipality.

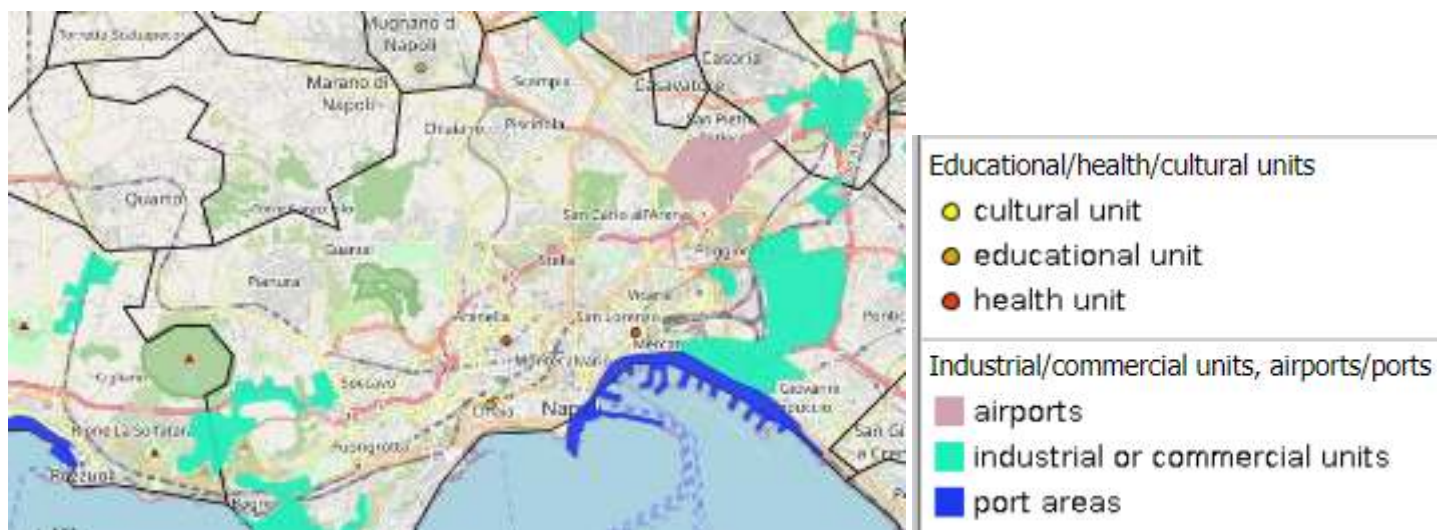
- **Step 5:** Open the drop-down list in the cell of Column “Current vulnerability level” and select the option that best reflects the assessed vulnerability level of the indicator.
- **Step 6:** In the last column “Indicator”, write down the indicators you have used for the vulnerability assessment.

Buildings sector

The available indicators of the UrbanProof toolkit that may be used for assessing the vulnerability level of Buildings against Floods, are the following: Critical infrastructure within a flood hazard zone. This is actually an indicator which is formulated by the combination of two geospatial information layers, (i) the Critical infrastructure and (ii) the Flood hazard zone area. Furthermore, the information on Critical infrastructure is provided through the UrbanProof toolkit in two individual layers: the Educational/health/cultural units layer and the Industrial/commercial units, airports/ports layer.

To explore information on this indicator, follow Steps 3-6 as indicated next (Steps 1 and 2 have already been applied).

- **Step 3:** Tick the box next to the Critical infrastructure and the Flood hazard zones layers in the left panel of Stage 2, located in the folder path *Impact assessment>Floods>Relevant information*, to generate information on the Critical infrastructure within a flood hazard zone
- **Step 4:** Copy the produced map of the municipality and paste it in Section Risks and Vulnerabilities assessment of your SECAP together with the relevant legend and examine the vulnerability level of the indicator for the municipality.



- Step 5: Open the drop-down list in the cell of Column “Current vulnerability level” and select the option that best reflects the assessed vulnerability level of the indicator.
- Step 6: In the last column “Indicator”, write down the indicators you have used for the vulnerability assessment.

IV. Climate hazard: Wild fires

In the Climate hazard Wild fires, choose as Relevant vulnerable sectors the following: Health, Agriculture & Forestry, Buildings

Agriculture & forestry sector

The available indicators of the UrbanProof toolkit that may be used for assessing the vulnerability level of Agriculture and Forestry sector against Wild fires, are the following: Land use flammability, Slope, Aspect.

To explore information on these indicators, follow Steps 3-7 as indicated next (Steps 1 and 2 have already been applied).

- Step 3: Tick the box next to the respective indicators in the left panel of Stage 2, located in the folder path *Impact assessment>Peri-urban fires>Relevant information*, to generate information on the Critical infrastructure within a flood hazard zone
- Step 4: Copy the produced map of the municipality and paste it in Section Risks and Vulnerabilities assessment of your SECAP together with the relevant legend and examine the vulnerability level of the indicator for the municipality with respect to Wild fires.
- Step 5: Repeat Steps 3 and 4 for each indicator.
- Step 6: Open the drop-down list in the cell of Column “Current vulnerability level” and select the option that best reflects the assessed vulnerability level of the indicators (provide a combined evaluation for the 3 indicators).
- Step 7: In the last column “Indicator”, write down the indicators you have used for the vulnerability assessment.

Health sector

The available indicator of the UrbanProof toolkit that may be used for assessing the vulnerability level of Health to Wild fires, is the following: Population density at fire risk areas.

To explore information on this indicator, follow Steps 3-9 as indicated next (Steps 1 and 2 have already been applied).

- Step 3: Tick the box next to the indicator Population density in the left panel of Stage 2, located in the folder path *Impact assessment>Other relevant indicators>Population density*
- Step 4: Copy the produced map of the municipality and paste it in Section Risks and Vulnerabilities assessment of your SECAP together with the relevant legend
- Step 5: At the top of the left panel, select “Baseline scenario (1971-2000)” at the Climate change scenario field.
- Step 6: Tick the box of the layer in the left panel “Mean peri-urban fire risk” located in the folder path *Impact assessment>Peri-urban fires*
- Step 7: Copy the produced map of the municipality and paste it in Section Risks and Vulnerabilities assessment of your SECAP together with the relevant legend, next to the map of Step 4. Then compare maps and estimate the Population density in the areas with high Mean peri-urban fire risk.
- Step 8: Open the drop-down list in the cell of Column “Current vulnerability level” and select the option that best reflects the assessed vulnerability level of the indicator.
- Step 9: In the last column “Indicator”, write down the indicators you have used for the vulnerability assessment.

Buildings sector

The available indicator of the UrbanProof toolkit that may be used for assessing the vulnerability of Buildings to Wild fires, is the following: Critical infrastructure within a high fire risk area. This is actually an indicator which is formulated by the combination of two geospatial information layers, (i) the Critical infrastructure and (ii) the High fire risk area. Furthermore, the information on Critical infrastructure is provided through the UrbanProof toolkit in two individual layers: the Educational/health/cultural units layer and the Industrial/commercial units, airports/ports layer.

To explore information on this indicator, follow Steps 3-8 as indicated next (Steps 1 and 2 have already been applied).

- Step 3: At the top of the left panel, select “Baseline scenario (1971-2000)” at the Climate change scenario field.
- Step 4: Tick the box next to the Critical infrastructure layers in the left panel of Stage 2, located in the folder path *Impact assessment>Floods>Relevant information*
- Step 5: Tick the box of the layer in the left panel “Mean peri-urban fire risk” located in the folder path *Impact assessment>Peri-urban fires*
- Step 6: Copy the produced map of the municipality and paste it in Section Risks and Vulnerabilities assessment of your SECAP together with the relevant legends and examine the vulnerability level of the indicator for the municipality.
- Step 7: Open the drop-down list in the cell of Column “Current vulnerability level” and select the option that best reflects the assessed vulnerability level of the indicator.
- Step 8: In the last column “Indicator”, write down the indicators you have used for the vulnerability assessment.

Table 3) Adaptive capacity

In Table 3, you may use the adaptive capacity factors available in the UrbanProof toolkit to assess the current adaptive capacity level of the identified Impacted sectors.

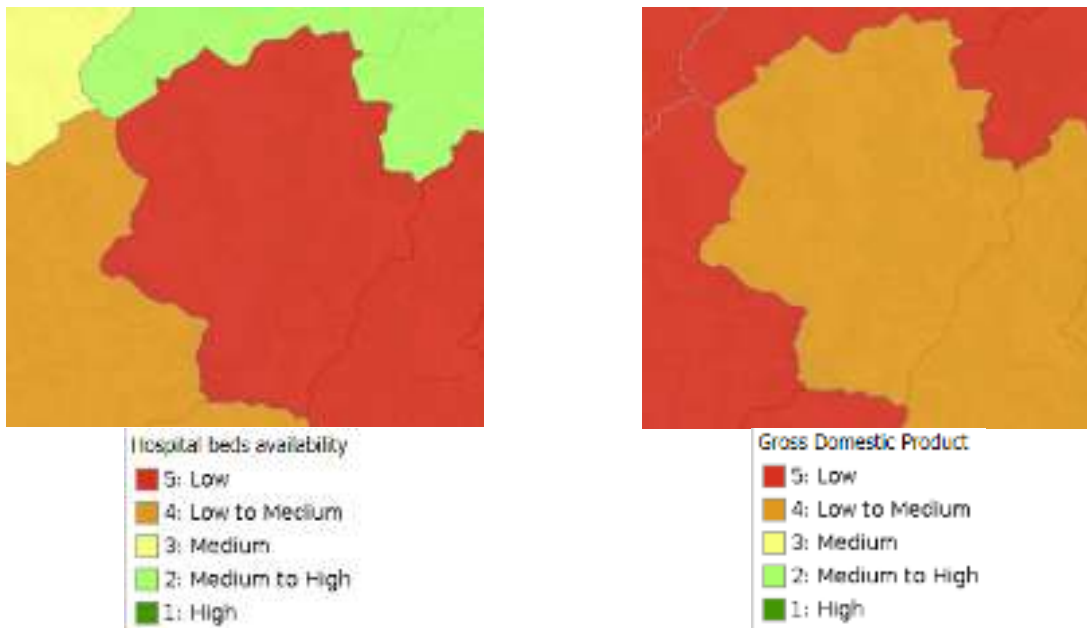
I. Impacted sector: Health

In the Impacted sector: “Health”, choose as Adaptive capacity factor: “Socio-economic”. Then in the last field “Indicator”, you may add in separate rows any of the following relevant indicators: Available hospital beds; GDP per capita.

To define Current adaptive capacity level for each of these indicators, follow Steps 3-6 as indicated next (Steps 1 and 2 have already been applied).

Table 3) Adaptive capacity					
	Impacted sector(s)	Relevant climate hazard(s)	Adaptive capacity factor(s)	Current adaptive capacity level	Indicator
<input checked="" type="checkbox"/>	Health	[to be generated automatically in online template]	Socio-economic	[Please choose]	[Choose from Annex 8 or write down your own]

- Step 3: Tick the box of the respective adaptive capacity layer (one at a time) in the left panel located in the folder path *Impact assessment>Other relevant indicators>Socio-economic vulnerability*
- Step 4: Copy the produced map of the municipality and paste it in Section Risks and Vulnerabilities assessment of your SECAP together with the relevant legend.
- Step 5: Open the drop-down list in the cell of Column “Current adaptive capacity level” and select the most relevant option.
- Step 6: Repeat Steps 3-5 for each adaptive capacity factor Impacted sector: Buildings



In the Impacted sector: “Buildings”, choose as Adaptive capacity factor: “Socio-economic”. Then in the last field “Indicator”, you may add the following relevant indicator: GDP per capita. To define Current adaptive capacity level for the selected adaptative capacity factor, follow Steps 3-6 as indicated at the Impacted sector: Health (see above).

II. Impacted sector: Energy

In the Impacted sector: “Energy”, choose as Adaptive capacity factor: “Socio-economic”. Then in the last field “Indicator”, you may add the following relevant indicator: GDP per capita. To define Current adaptive capacity level for the selected adaptative capacity factor, follow Steps 3-6 as indicated at the Impacted sector: Health (see above).

III. Impacted sector: Agriculture and forestry

In the Impacted sector: “Health”, you may choose as Adaptive capacity factor: “Socio-economic”. Then in the last field “Indicator”, you may add the following relevant indicator: GDP per capita. To define Current adaptive capacity level for the selected adaptative capacity factor, follow Steps 3-6 as indicated at the Impacted sector: Health (see above).

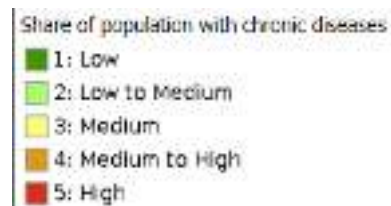
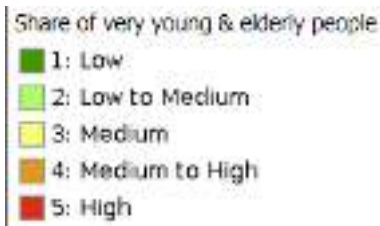
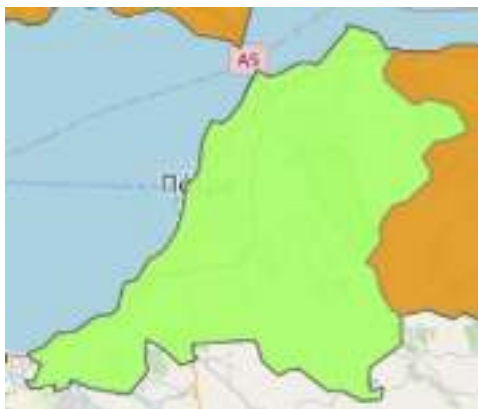
Table 4) Vulnerable population groups

In Table 4, you may select for each of the identified Climate hazards, the population groups that are considered vulnerable to the hazard. The UrbanProof toolkit provides information on the share of several vulnerable population groups at municipal or national level, i.e. Share of very young & elderly population (municipality level), Share of population with chronic diseases (national level); Share of population at poverty risk (national level); Illiteracy rate (municipality level).

Table 4) Vulnerable population groups	
Climate hazards	Most vulnerable population group(s)
<input type="checkbox"/> Extreme heat	[Choose from the list above]

To explore information on these indicators, follow Steps 3-6 as indicated next (Steps 1 and 2 have already been applied).

- **Step 3:** Next to the selected Climate hazards, in the Column “Most vulnerable population group(s)”, open the drop-down list and select a vulnerable population group, that is available in the UrbanProof toolkit.
- **Step 4:** Tick the box next to the respective indicator in the left panel of Stage 2, located in the folder path *Impact assessment>Other relevant indicators>Socio-economic vulnerability*
- **Step 5:** Copy the produced map of the municipality and paste it in Section Risks and Vulnerabilities assessment of your SECAP together with the relevant legend and examine the population share of the vulnerable population group.
- **Step 6:** Repeat Steps 3-5 for each vulnerable population group.

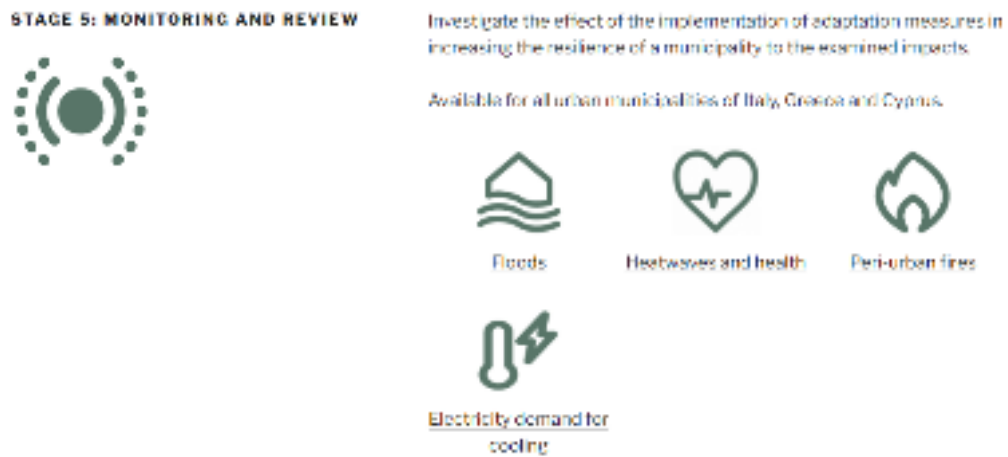




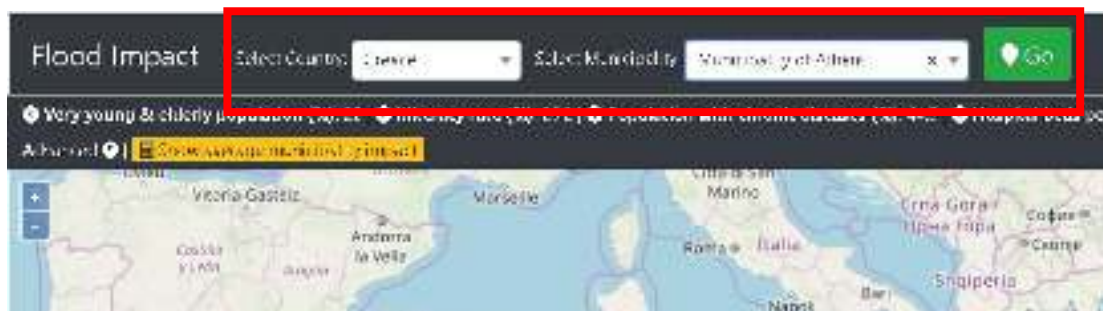
3.2 Stage 5: Setting quantitative targets

In Stage 5 of the UrbanProof toolkit, the user may investigate the effect of the selected adaptation measures in increasing the resilience of an urban municipality in Italy, Greece or Cyprus, for specific impacts. This stage is useful for setting quantitative targets for the Climate Action Plan, but also for monitoring the progress in achieving the targets set during the implementation of the plan.

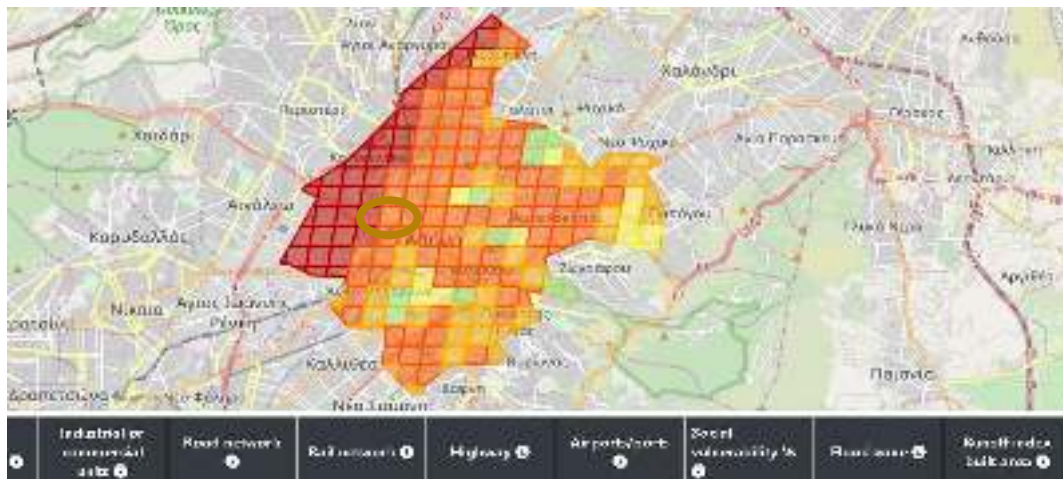
To start with, the user first selects the impact to be examined, by clicking on the respective impact icon of Stage 5 at the [homepage](#) of the UrbanProof toolkit.



The user is then directed to a new screen where he/she is asked to select the country and the specific municipality under examination.



By clicking on the “Go” button, the results of the impact assessment are presented for the selected municipality. The user may also see the average impact value for the whole municipality, by selecting the “Show average municipality impact” button above the map.



The values of the indicators used in the assessment, as well as those of the final impact result, are presented for each cell of the map, at the table located below the map. In particular, each cell of the map corresponds to a row of the table.

To investigate the effect of the implementation of an adaptation measure in decreasing the initially estimated impact, the user first selects at the map the cell where he/she wishes to implement an adaptation measure. Then, the respective row of the table is activated for editing. Next, the user defines the area that he/she wishes to implement the adaptation measure, as well as the measure he/she wishes to implement from the respective dropdown menu. Finally, he/she selects the tick symbol to show the updated impact results.

Adaptation area (m2) ⁱ	Adaptation area (%) ⁱ	Adaptation intervention ⁱ	Weighted runoff index ⁱ	Flood impact ⁱ	
5000	2.00	Tree plantation (>50% cover) value:0.23	0.48	3.59	

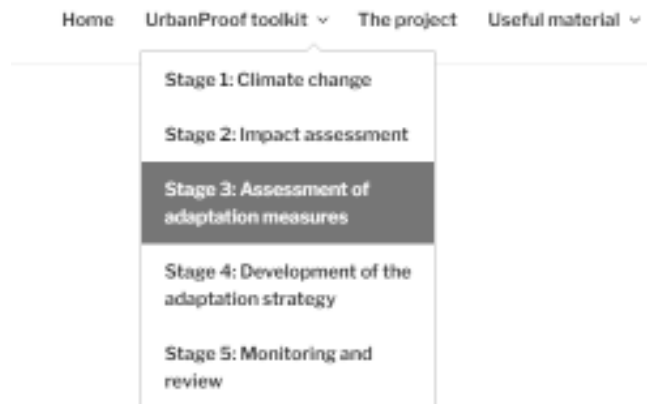
It is noted that in order to achieve a reduction of the estimated impact at municipal level, the user should apply measures at a wider area, that is, to a greater number of cells, especially to those where higher impacts are foreseen. Once the user applies these changes, then he/she may select the “ Show average municipality impact” option to see if and how much, the initial impact has been reduced.

For detailed guidance on the use of Stage 5, one may also consult the [User manual](#)⁷.

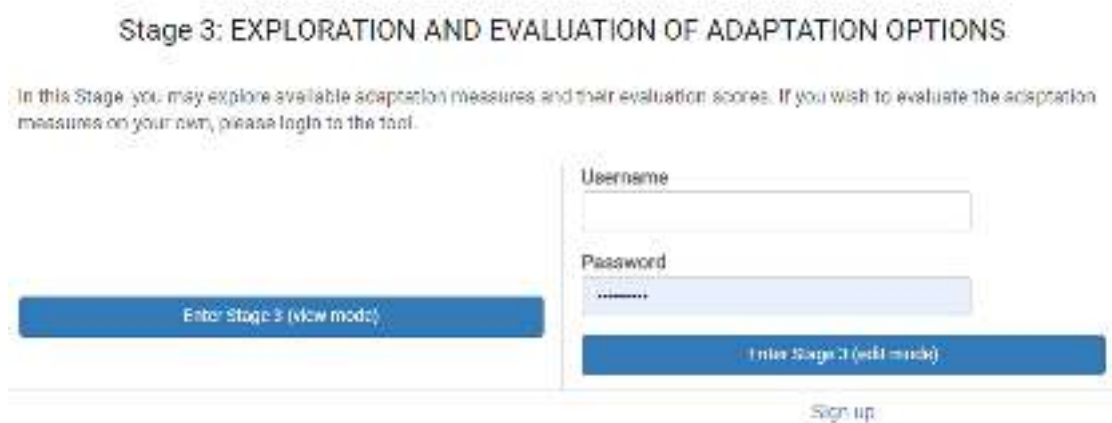
⁷ https://tool.urbanproof.eu/wp-content/uploads/2021/02/UrbanProofManualEN_02_2021.pdf

3.3 Stages 3 and 4: Identification, assessment and selection of adaptation actions

From the [homepage](#) of the UrbanProof toolkit, select “Stage 3: Assessment of adaptation measures” either from the top menu or from the respective section of the homepage.



In Stage 3, the user may either explore the available adaptation measures and their evaluation scores provided by a “pool of experts” of the UrbanProof project, or to evaluate the adaptation measures by setting his or her own values. The latter requires user authentication via login in order to enable saving of the data inserted by the user. To login, select Sign Up and then in the new window, fill the required fields.



When entering Stage 3, the user may see the technical, environmental and techno-economic criteria used for the evaluation of the adaptation measures with the MultiCriteria Analysis (MCA) method. The user may modify the weights assigned to the criteria according to his/her personal perception of their relevant importance. The weights to each criterion may range from 0 to 100, while the sum of all weights should equal to 100. When finish weighting, press "Save".

Measure	Efficiency in addressing the impact	Environmental Friendliness	Economic Viability	Job growth
Values	20	10	50	20

If you wish to evaluate the available adaptation measures for each impact, select the respective impact from the top menu. In the new tab, evaluate the adaptation measures provided in the first column of the table against the criteria of the top row. The evaluation scores may range from 0 (poor performance) to 100 (high performance). When you finish the evaluation press 'Save' and go to Stage 4 to see the evaluation results.

Measure	Efficiency in addressing the impact Current Weight: 20	Environmental Friendliness Current Weight: 10	Economic Viability Current Weight: 50	Job growth Current Weight: 20
Green Roofs	80	60	30	50
Trees in urban areas	94	92	91	47
Channels and ditches	65	69	45	51

In Stage 4, the adaptation measures are prioritized based on the ratings provided in Stage 3 for the multi-criteria analysis (MCA). The total score for each measure is calculated as the weighted sum of the score to each criterion and the weight of the respective criterion. The measures gathering the higher ratings may be included in the Local Adaptation Plan of the municipality.

Measure	Final score
Holistic Energy Efficient Retrofitting of Residential Buildings	70.04
Economic incentives for renewables and energy efficiency	68.92
Renovation of municipality buildings to Nearly Zero-Energy Buildings	67.96
Demonstration projects and educational programs	65.25
Urban parks	64.02
Cool Roofs	63.37