HEAT RELATED IMPACT ASSESSMENT ON URBAN MUNICIPALITIES

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LIFE URBANPROOF
CLIMATE PROOFING
URBAN MUNICIPALITIES

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IMPACT ASSESSMENT METHODOLOGY

- The impact assessment methodology is based on the relevant conceptual framework presented within the 5th Assessment Report (AR5) of the IPCC (2014)
- 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 are used to reflect the relevant climatic information for each impact
- **Exposure** indicators reflect the exposure of population, land and/or critical infrastructure to an impact
- **Sensitivity** indicators are used to reflect the population groups which are considered sensitive to climate change
- The **adaptive capacity** indicators refer to both the capacity of the health care system and of the economy to address climate change impacts.

- ***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 NewYork, NY, USA, pp. 1-32*

IMPACT ASSESSMENT APPROACH

- For assessing total climate change impacts, the **composite indicator** approach is selected, as composite indices capture the multi-dimensionality of impacts in a comprehensible form and therefore may support practical decision-making processes.
- The assessment is made at **spatial level** with the use of maps, in order to provide relevant stakeholders with information about where the highest impacts are expected and to guide the allocation of resources for targeting adaptation assistance (USAID, 2014).
- Indicators were **normalized** by applying the min-max method (OECD 2008), while a five-class system was then applied representing values from "High" to "Low".
- Following, indicators were assigned with **weights** which were defined through expert judgement. The method used for **aggregating** the individual impact indicators into the composite impact indicator is the *weighted arithmetic aggregation method* (OECD 2008), which is also the one recommended in the Vulnerability Sourcebook (Fritzsche et al. 2014).

- ***Fritzsche**, K., Schneiderbauer, S., Bubeck, P., Kienberger, S., Buth, M., Zebisch, M., & Kahlenborn, W. 2014: The Vulnerability Sourcebook: Concept and guidelines for standardised vulnerability assessments. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH*
- ***OECD 2008:** Handbook on constructing composite indicators: methodology and user guide. Technical Report. Paris: OECD Publishing*
- ***USAID 2014:** Spatial Climate Change Vulnerability Assessments: A Review of Data, Methods, and Issues. USA: United States Agency for International Development.*

SOCIAL VULNERABILITY INDEX

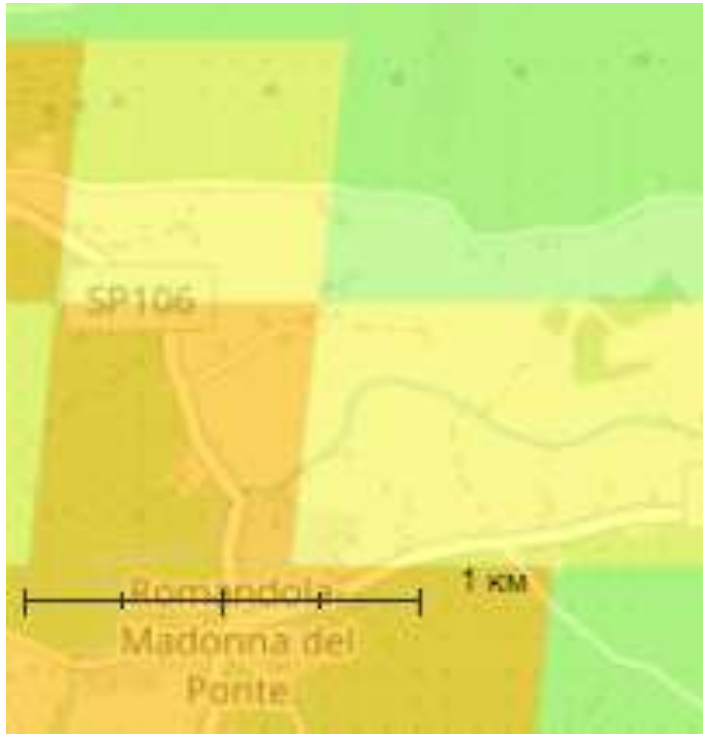
- The social vulnerability indicators are combined to form the composite Social vulnerability index, which reflects the population groups sensitive to climate change impacts and the adaptive capacity of the health care system and of the economy.
- The socio-economic indicators selected are among those widely used in the literature for the assessment of the vulnerability to climate change impacts on the urban environment.
- The selection criteria for the indicators were: relevancy, adequacy as well as uniform and consistent data availability at the relevant geospatial level for the three project countries.
- The sensitivity indicators are proportionally related to vulnerability, as the higher the sensitivity the higher the vulnerability, while the adaptive capacity indicators are inversely related to vulnerability, as the higher the adaptive capacity, the lower the vulnerability.
- The indicators are normalized based on their position with respect to the respective European average value (above/below average EU value).
- The data are sourced from the National Statistical Services of the three countries as well as from Eurostat.

SOCIO-ECONOMIC INDICATORS

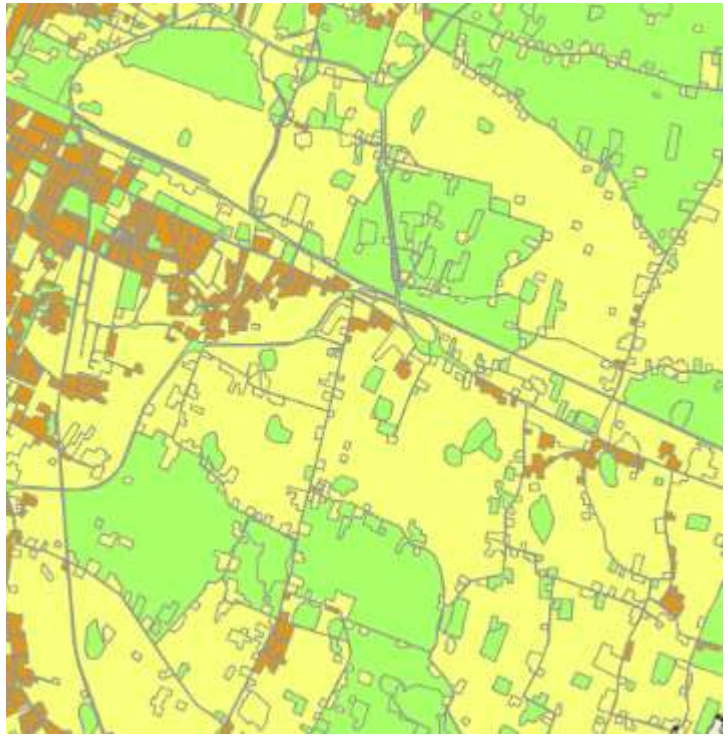
- **Very young & elderly population :** The indicator refers to the percentage of people over 70 years old plus the percentage of people under 9 years old and is used to account for the increased sensitivity of these groups to the climate change impacts under study. The data are available at municipal level.
- **Illiteracy rate:** The indicator created to reflect this population group is actually the percentage of people within the age group 15-75, with educational level up to lower secondary school, including the illiterate and the literate with lack of an official educational level or those who gave up school. This is the lowest education attainment level for which data could be found for the same age groups at municipal level. However, it is considered to be indicative of the illiteracy level. The data are available at municipal level.
- **Population with chronic diseases :** The indicator refers to the percentage of people with chronic diseases (asthma, chronic lower respiratory-excluding asthma, high blood pressure, stroke or chronic stroke disease, diabetes, chronic depression). This information is available at national level only and therefore the values assigned to each municipality are the respective national ones.
- **Available hospital beds:** The indicator refers to the available hospital beds per 100,000 inhabitants and is available at regional level. Therefore the values assigned to each municipality are the respective regional ones.
- **Population with chronic diseases :** The indicator refers to the percentage of people with chronic diseases (asthma, chronic lower respiratory-excluding asthma, high blood pressure, stroke or chronic stroke disease, diabetes, chronic depression). This information is available at national level only and therefore the values assigned to each municipality are the respective national ones.
- **People at risk of poverty :** The indicator created to reflect this population group is actually the percentage of population exposed to poverty risk. This information is available at national level only and therefore the values assigned to each municipality are the respective national ones.
- **GDP per capita**: The indicator refers to "Euros per inhabitant" and is expressed as percentage of the EU average value. This information is available from Eurostat (2016) at regional (NUTS2) level and therefore the values assigned to each municipality are the respective regional ones.

RESOLUTION ANALYSIS

All urban municipalities: Presentation of results in grid cells of 500x500m



LIFE URBANPROOF project municipalities: Presentation of results in urban block level

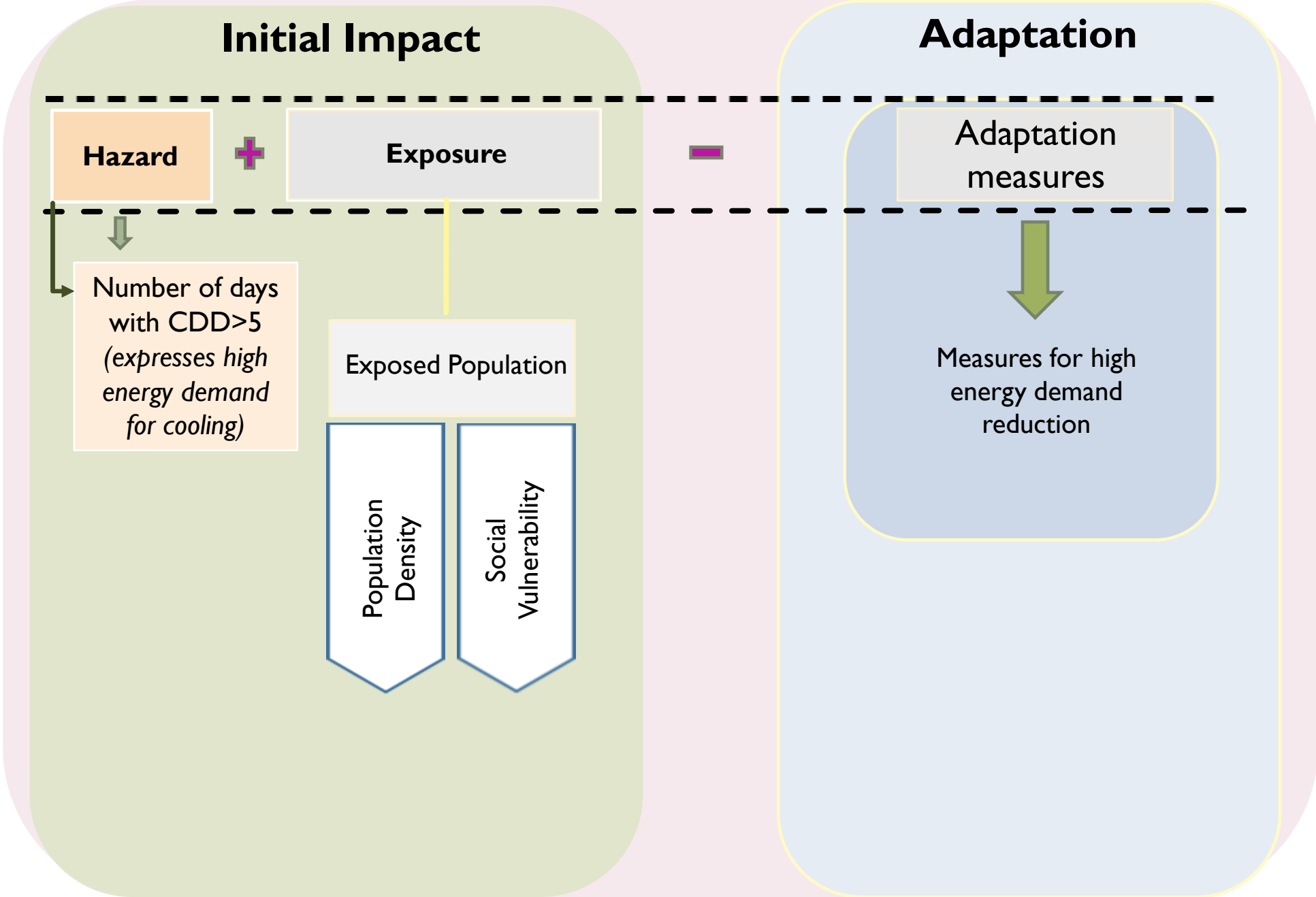


This applies for Stage 2.The results of Stage 5 are presented for all urban municipalities in grid cells of 500x500m

ELECTRICITY DEMAND FOR COOLING

- The impact of increased temperatures on the electricity demand for cooling is conceived as a function of climate change hazards and the vulnerability of the exposed population.
- The assessment was based on the indicator CDD (Cooling Degree Days), which reflects the demand for energy needed to cool a building.
- In specific, the number of days where the Cooling Degree Days (CDD) is above 5 (i.e. days with great electricity demand for cooling) was used for the assessment of the climatic hazard
- The vulnerability of the exposed population was estimated based on the composite Social Vulnerability index and the population density.
- The implementation of adaptation measures addressing increased electricity demand due to heat is considered to reduce impact.

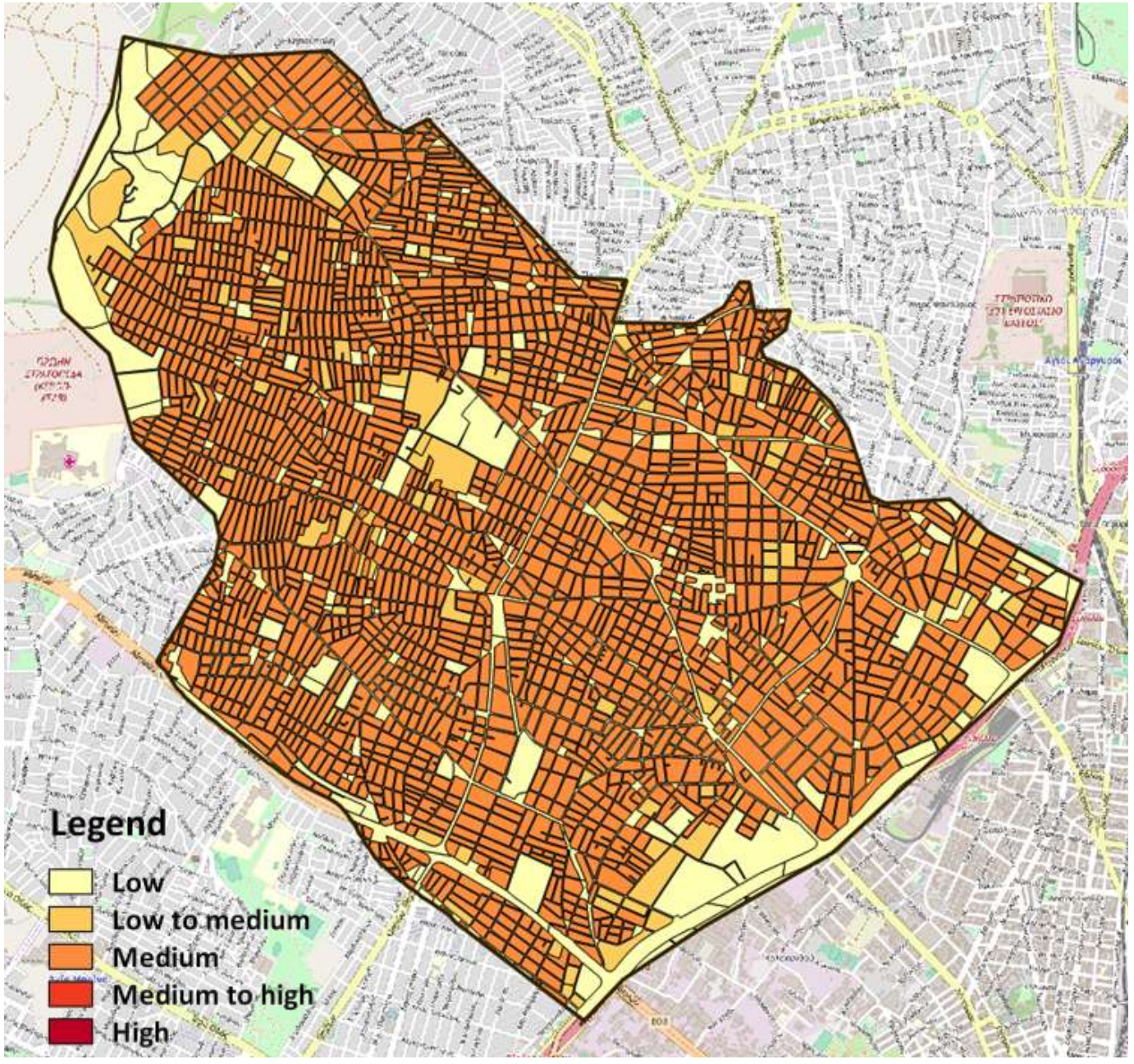
ELECTRICITY DEMAND FOR COOLING IMPACT ASSESSMENT



ELECTRICITY DEMAND FOR COOLING – PERISTERI

REFERENCE PERIOD

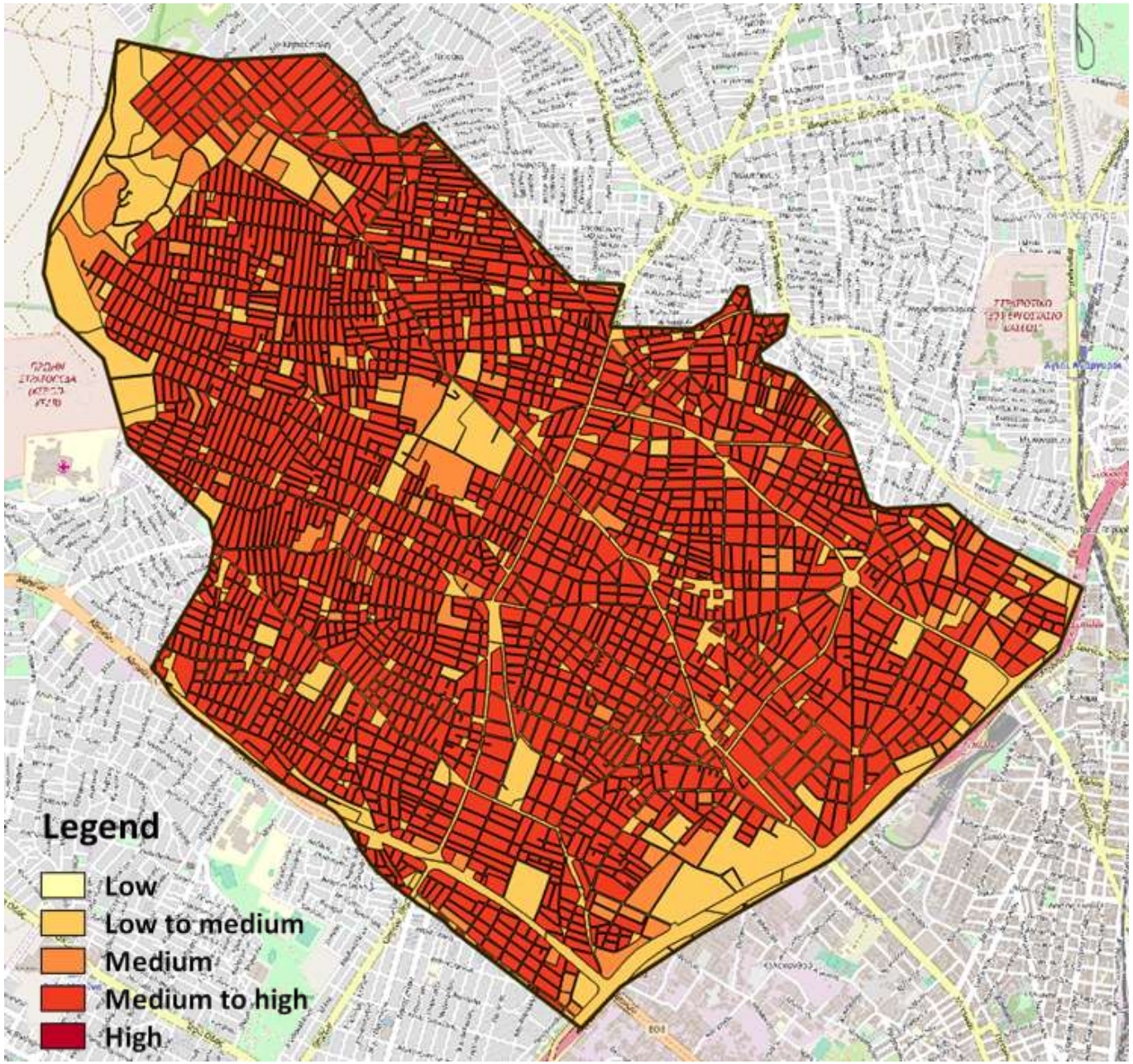
ΚΛΑΣΗ	ΕΚΤΑΣΗ (%)
1: Χαμηλή	32
2: Χαμηλή προς μέση	7
3: Μέση	61



ELECTRICITY DEMAND FOR COOLING – PERISTERI

FUTURE PERIOD – RCP 4.5

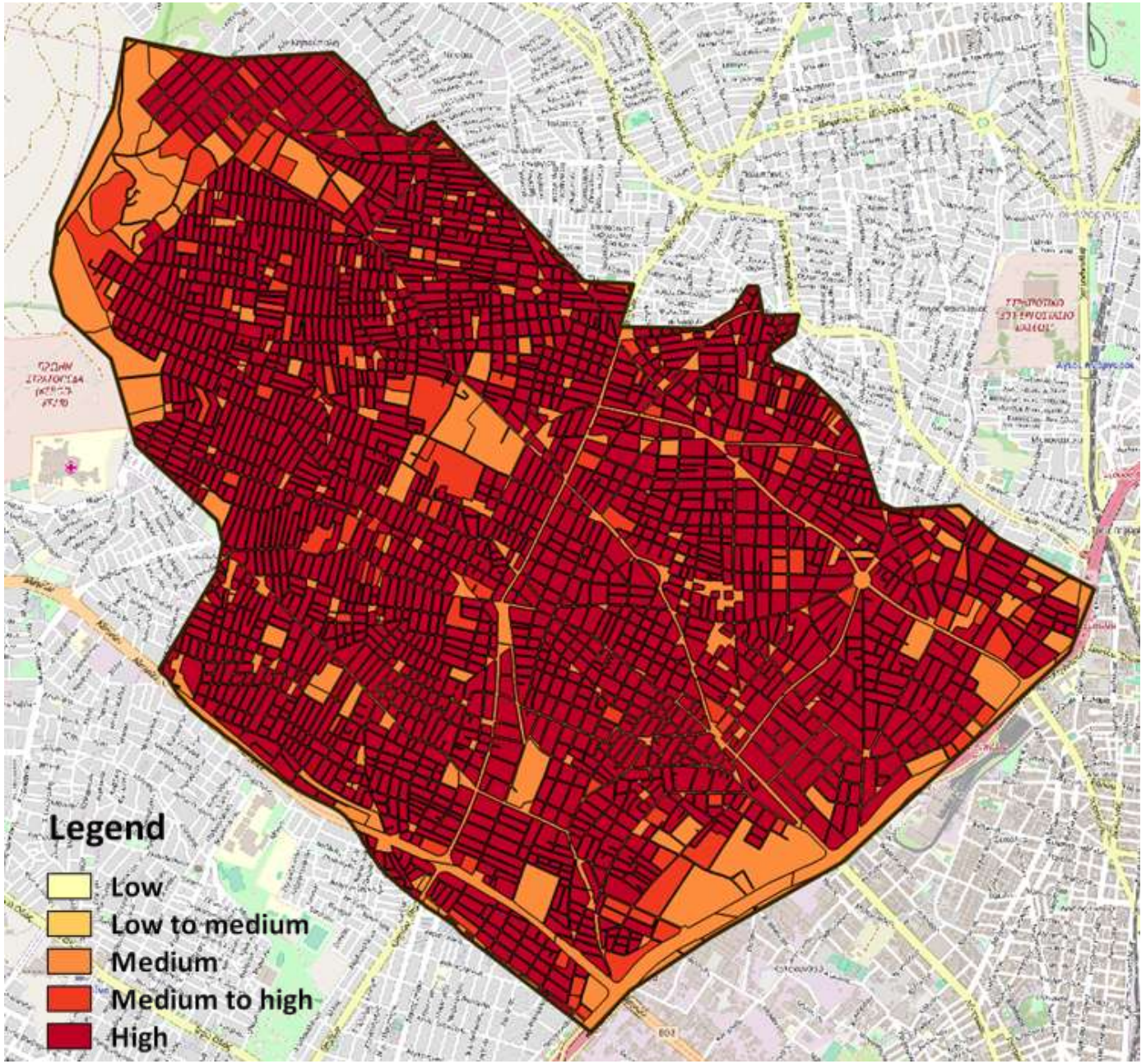
ΚΛΑΣΗ	ΕΚΤΑΣΗ (%)
2: Χαμηλή προς μέση	32
3: Μέση	7
4: Μέση προς μεγάλη	61



ELECTRICITY DEMAND FOR COOLING – PERISTERI

FUTURE PERIOD – RCP 8.5

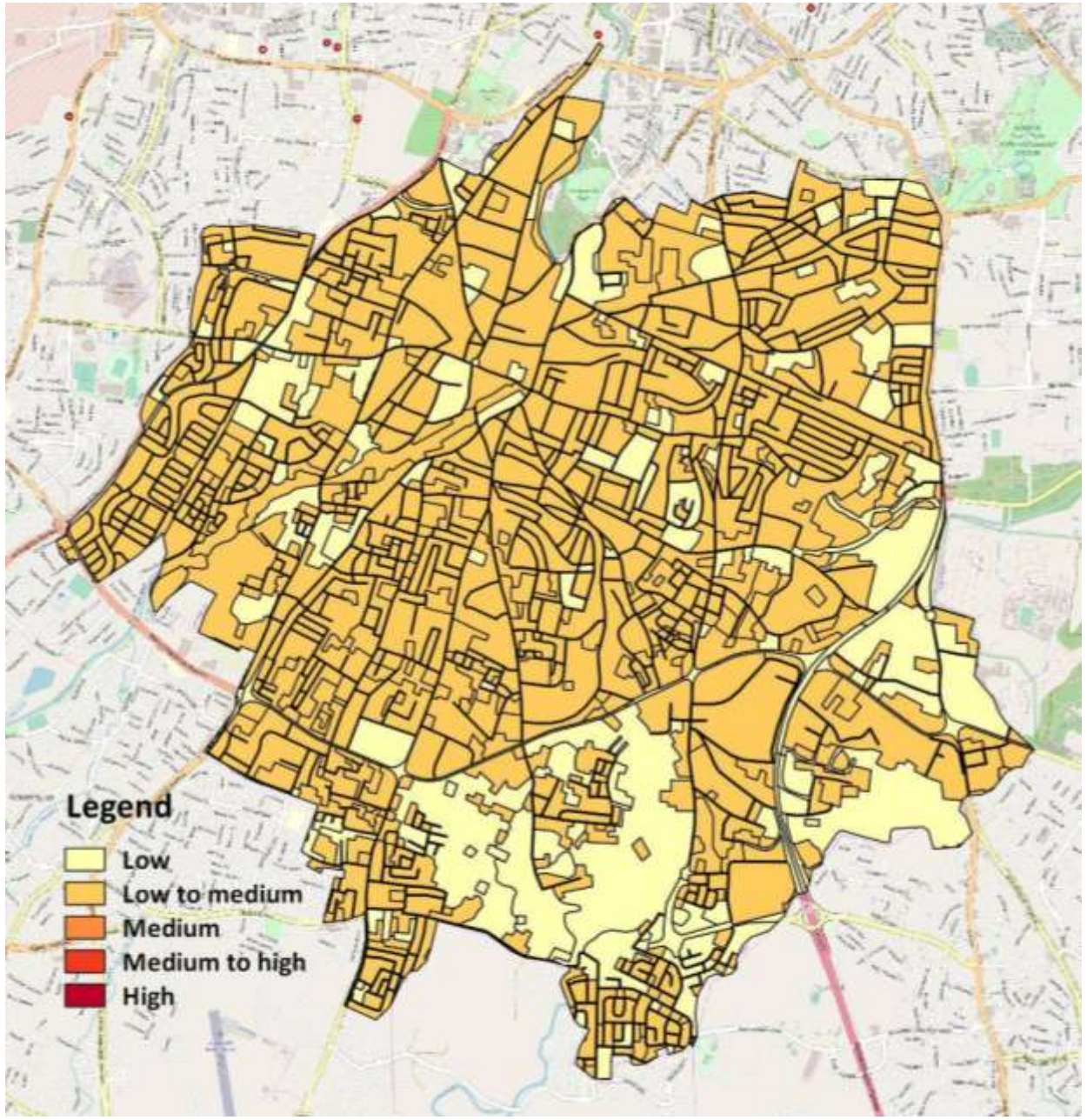
ΚΛΑΣΗ	ΕΚΤΑΣΗ (%)
3: Μέση	32
4: Μέση προς μεγάλη	7
5: Μεγάλη	61



ELECTRICITY DEMAND FOR COOLING – STROVOLOS

REFERENCE PERIOD

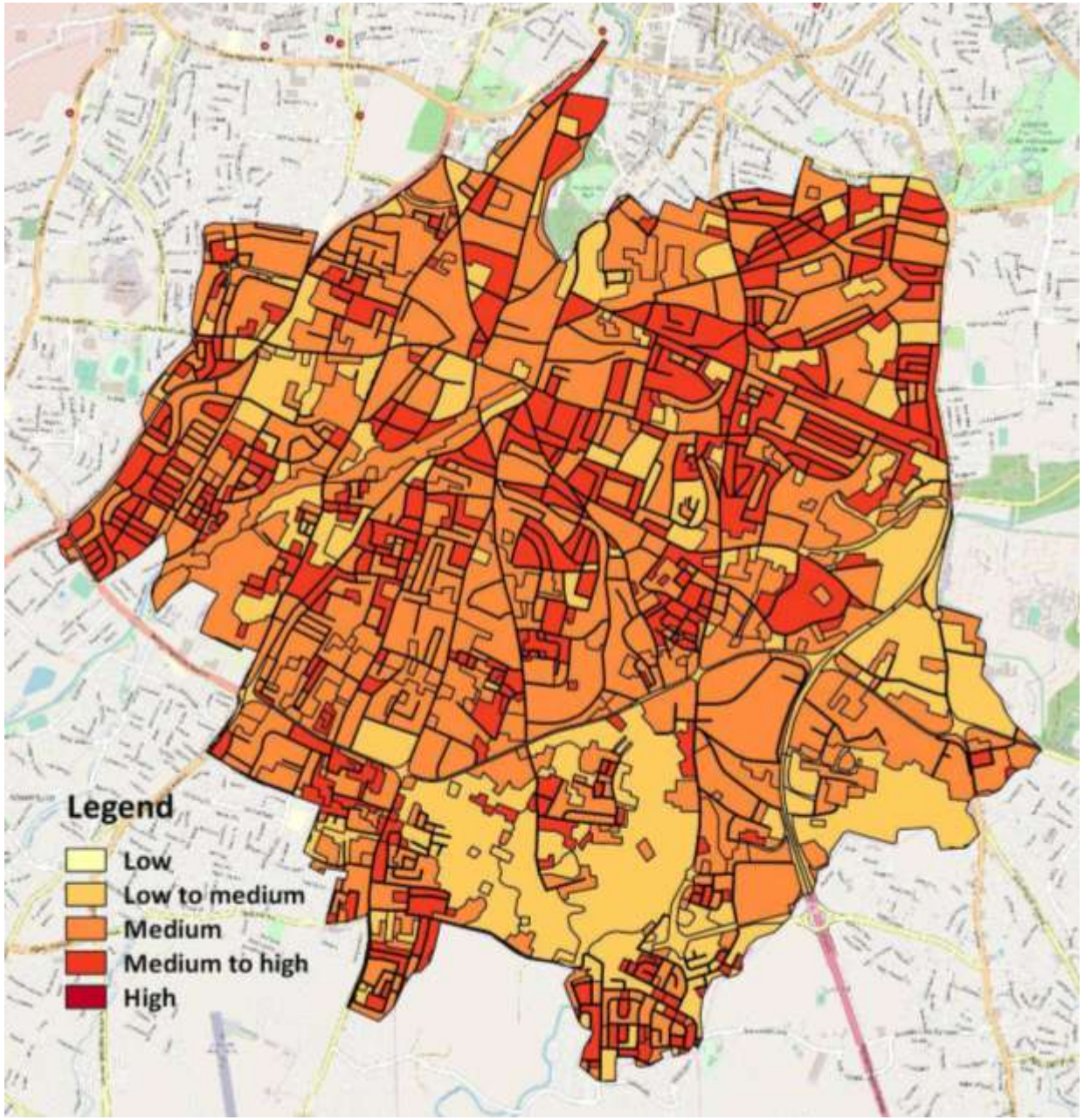
CLASS	AREA (%)
1: Low	30
2: Low to medium	70



ELECTRICITY DEMAND FOR COOLING – STROVOLOS

FUTURE PERIOD – RCP 4.5

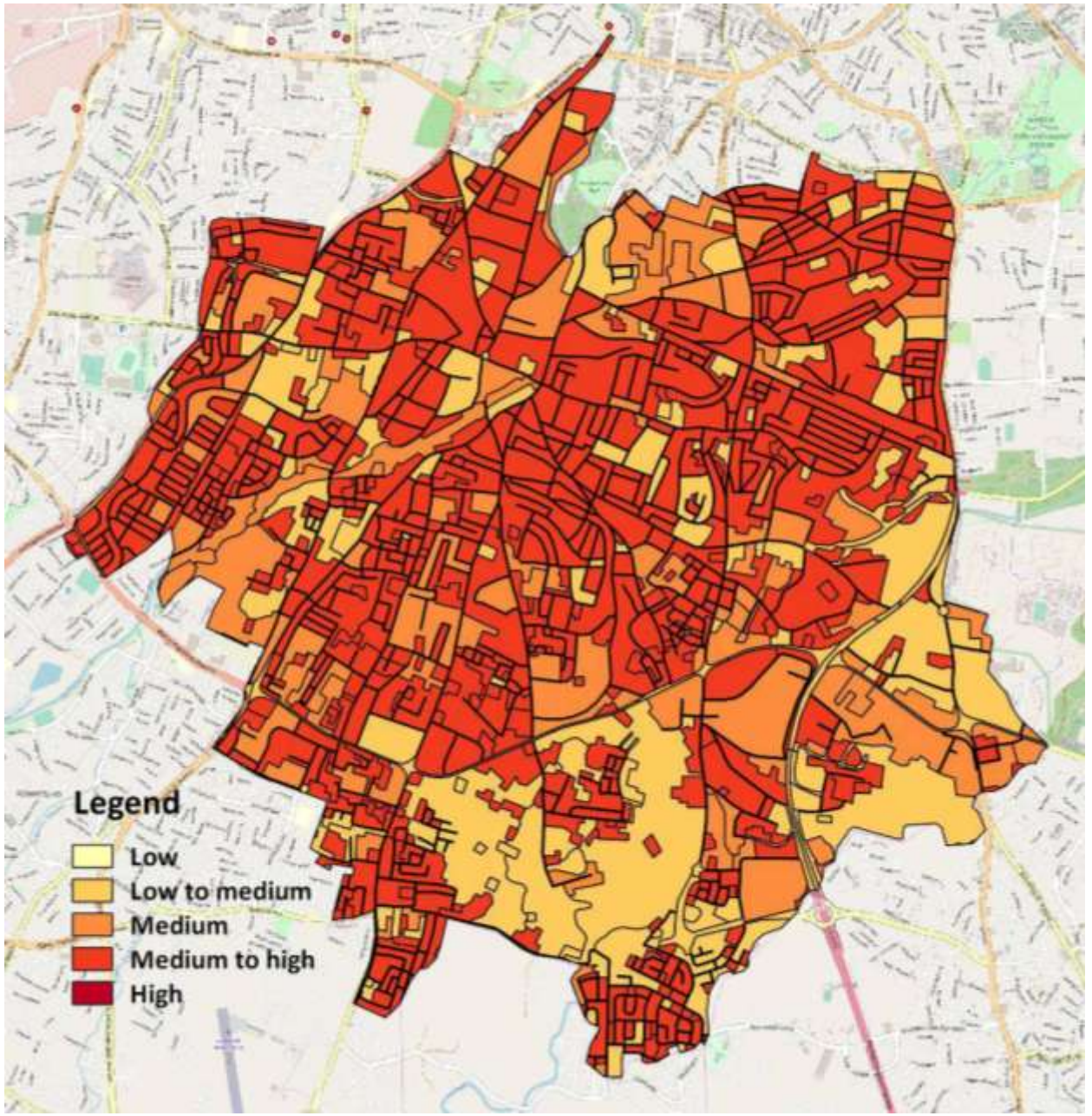
CLASS	AREA (%)
2: Low to medium	30
3: Medium	50
4: Medium to high	20



ELECTRICITY DEMAND FOR COOLING – STROVOLOS

FUTURE PERIOD – RCP 8.5

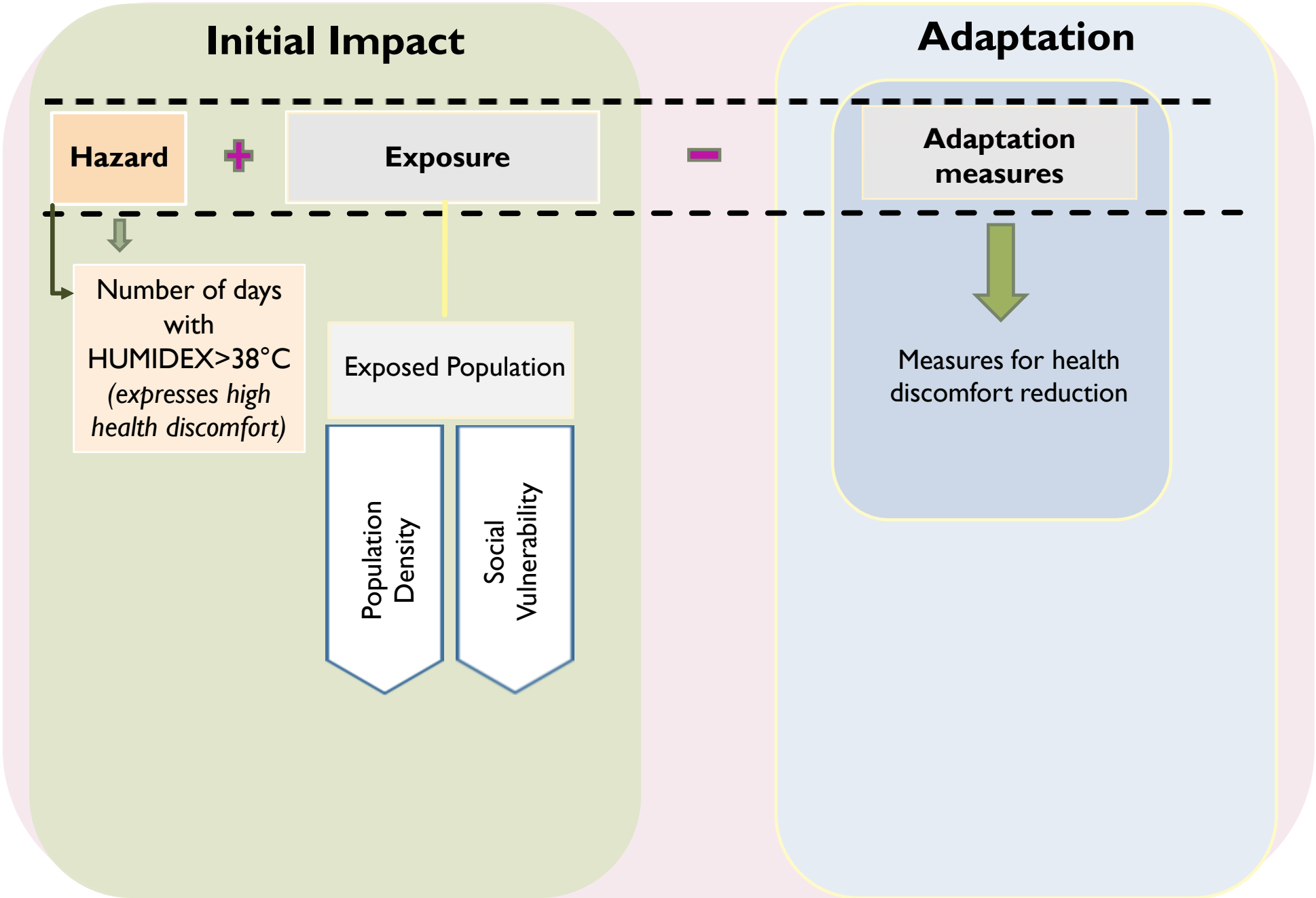
CLASS	AREA (%)
2: Low to medium	30
3: Medium	20
4: Medium to high	50



HEATWAVES AND HEALTH

- The impact of heatwaves on health is conceived as a function of climate change hazards and the vulnerability of the exposed population.
- HUMIDEX, which is a climatic indicator reflecting the impacts of temperature and humidity on human discomfort, was used to depict hazard. In specific, the number of days with HUMIDEX above 38°C which expresses high discomfort, was selected as indicator of hazard.
- The vulnerability of the exposed population was estimated based on the composite Social Vulnerability index and the population density.
- The implementation of adaptation measures addressing human discomfort due to heat is considered to reduce impact.

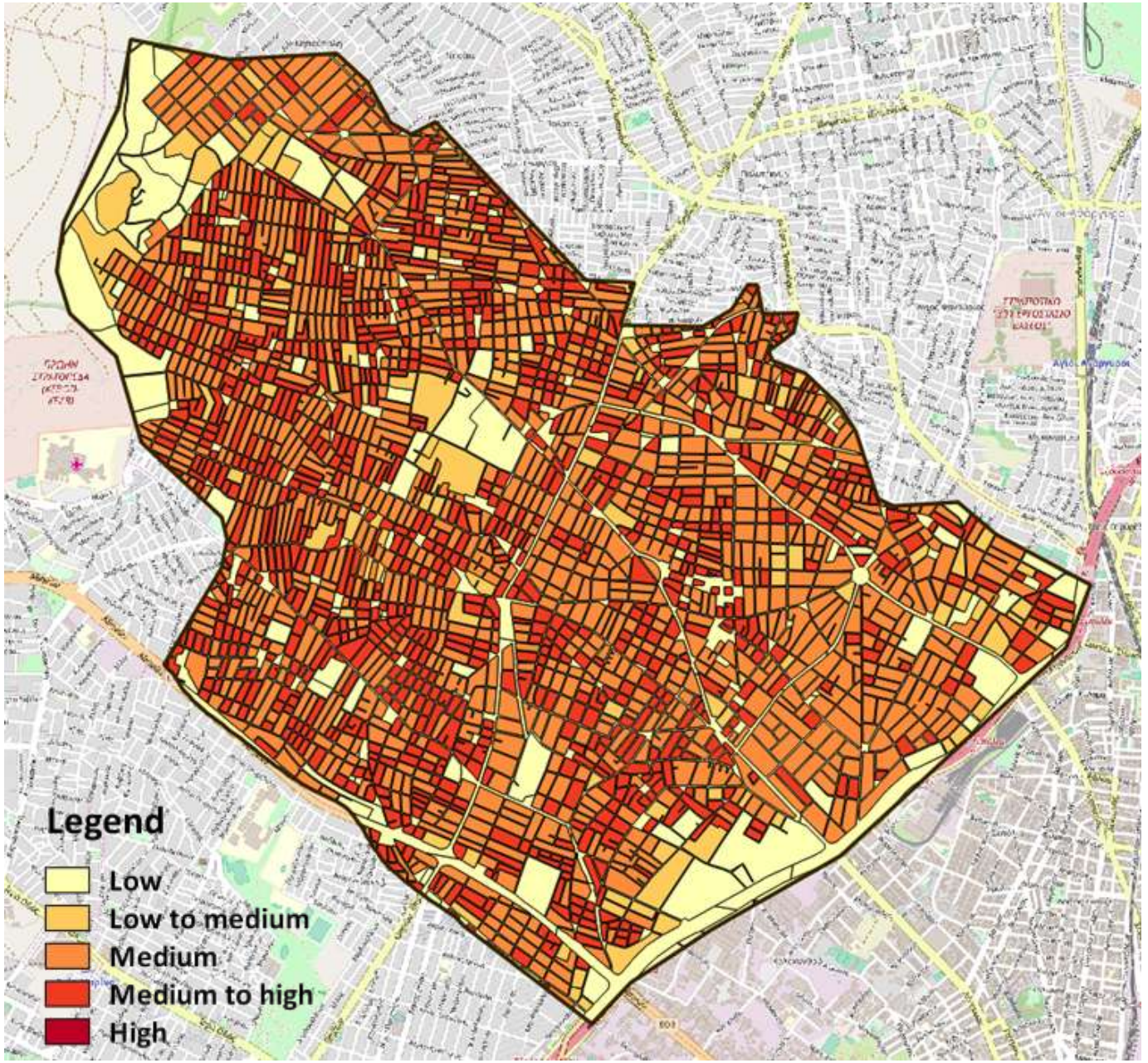
HEATWAVES AND HEALTH IMPACT ASSESSMENT



HEATWAVES AND HEALTH – PERISTERI

REFERENCE PERIOD

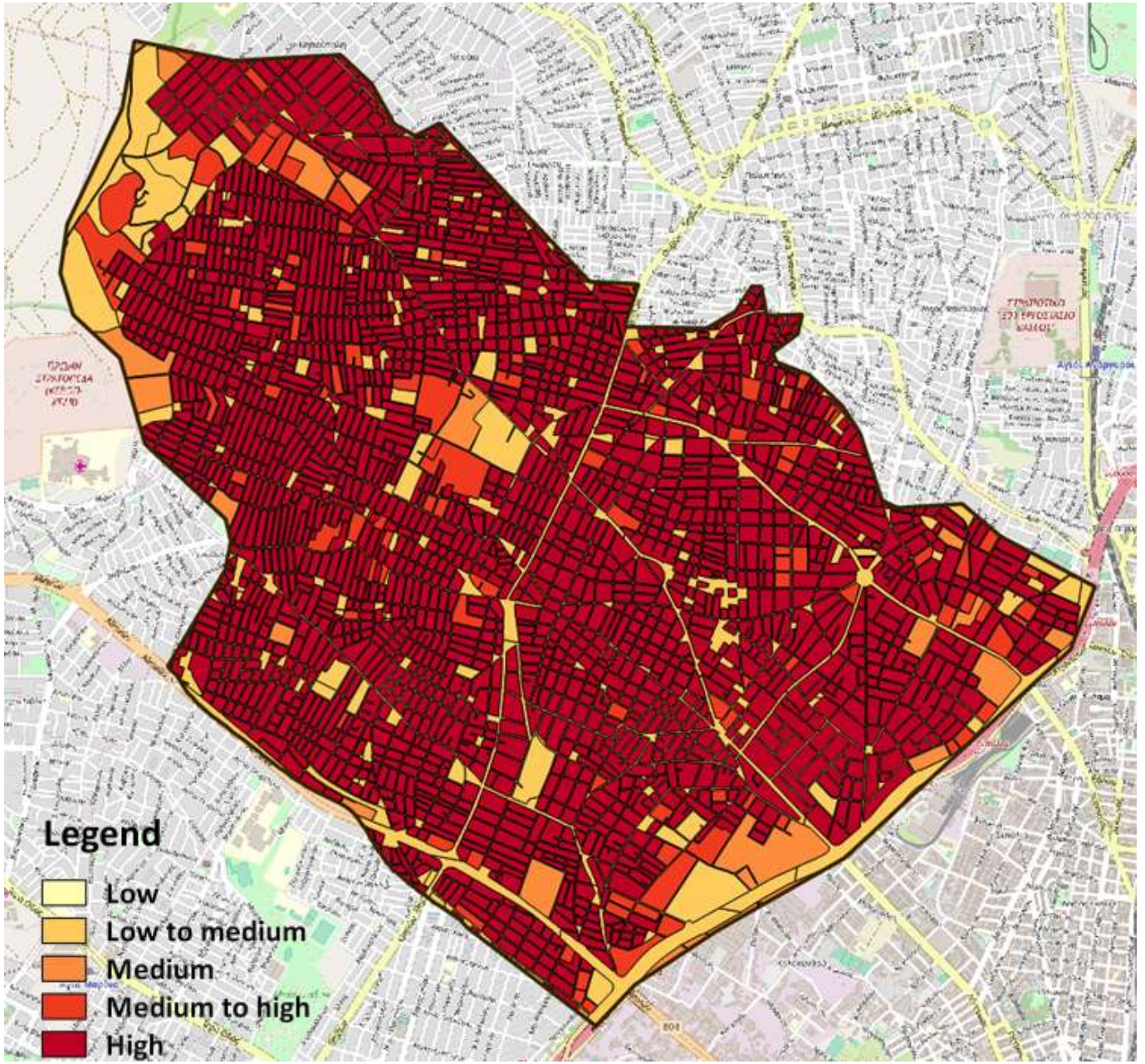
CLASS	AREA (%)
1: Χαμηλή	32
2: Χαμηλή προς μέση	7
3: Μέση	40
4: Μέση προς μεγάλη	21



HEATWAVES AND HEALTH – PERISTERI

FUTURE PERIOD – RCP 4.5 & RCP 8.5

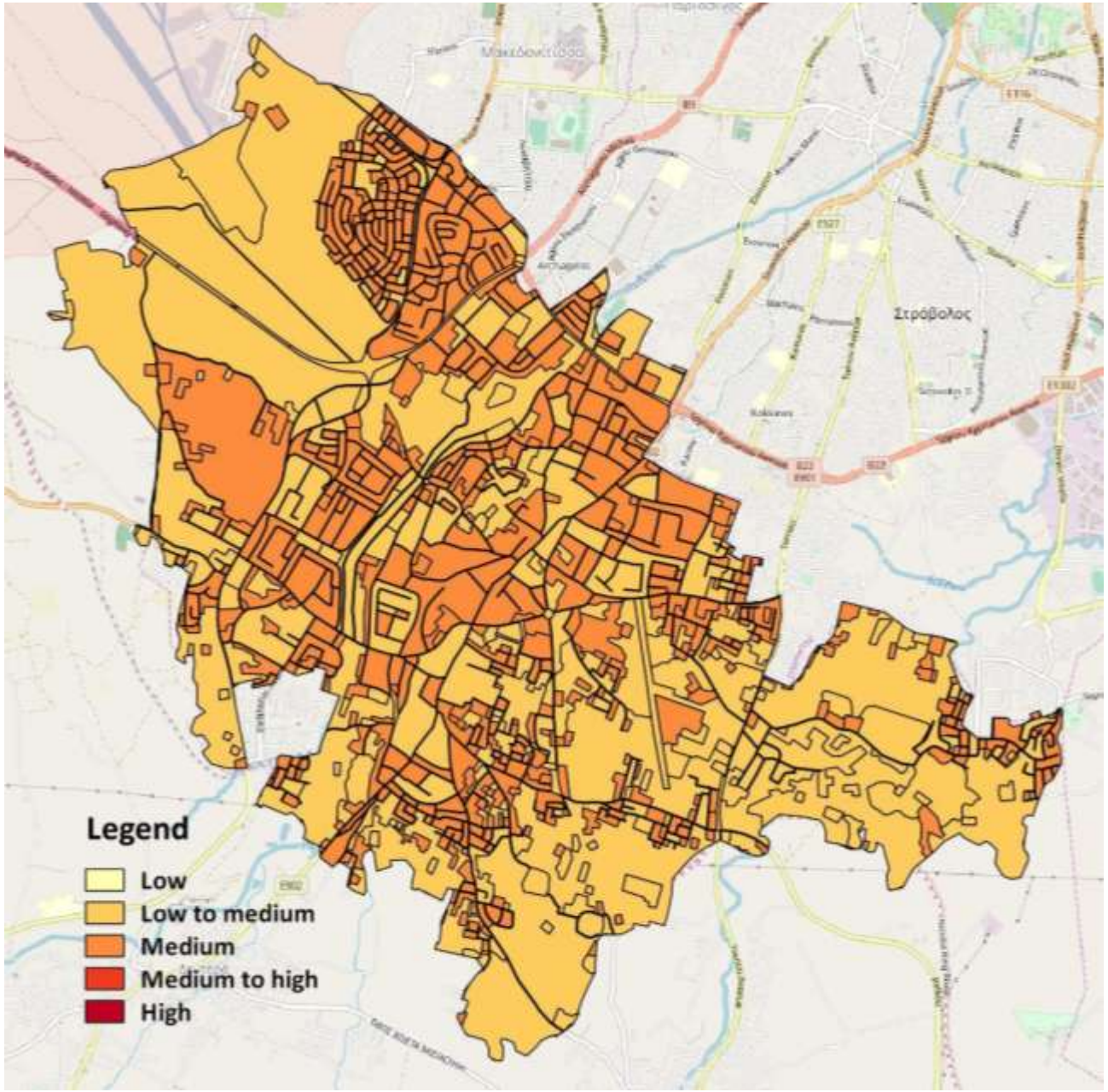
CLASS	AREA (%)
2: Χαμηλή προς μέση	28.3
3: Μέση	3.8
4: Μέση προς μεγάλη	6.6
5: Μεγάλη	61.3



HEATWAVES AND HEALTH – LATATAMIA

REFERENCE PERIOD

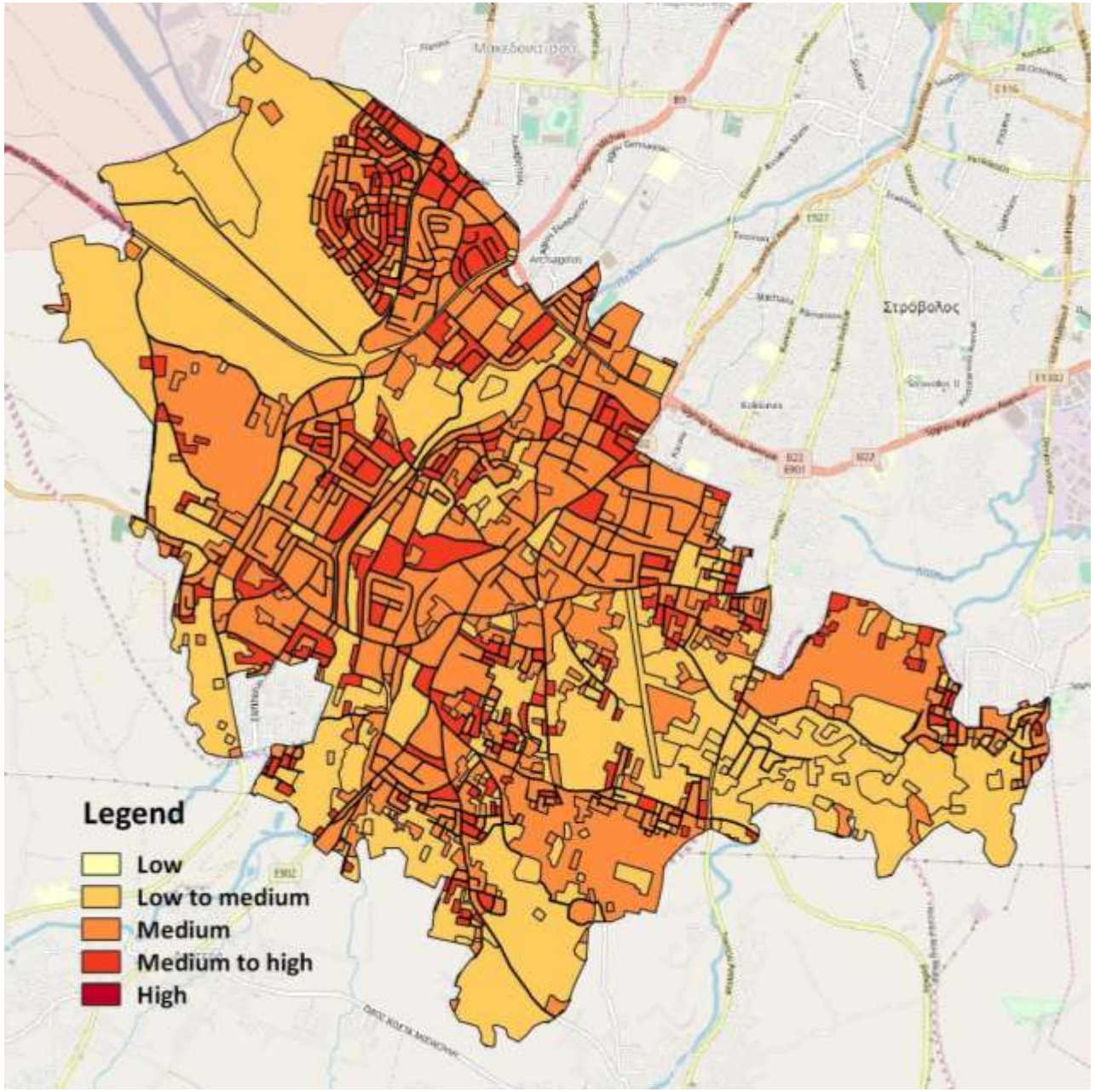
CLASS	AREA (%)
2: Low to medium	66
3: Medium	34



HEATWAVES AND HEALTH – LATATAMIA

FUTURE PERIOD – RCP 4.5

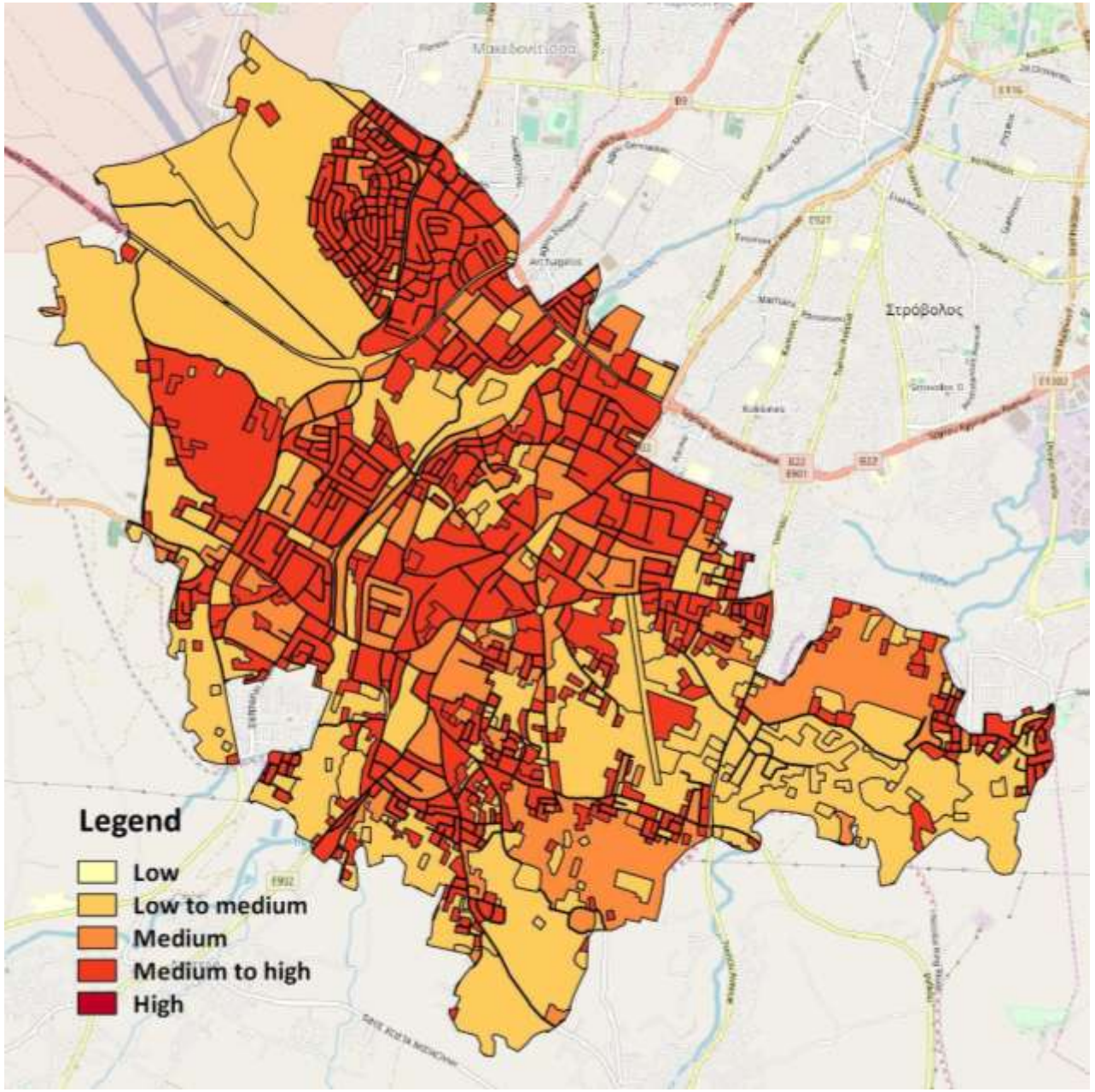
CLASS	AREA (%)
2: Low to medium	50
3: Medium	41
4: Medium to high	9



HEATWAVES AND HEALTH – LATATAMIA

FUTURE PERIOD – RCP 8.5

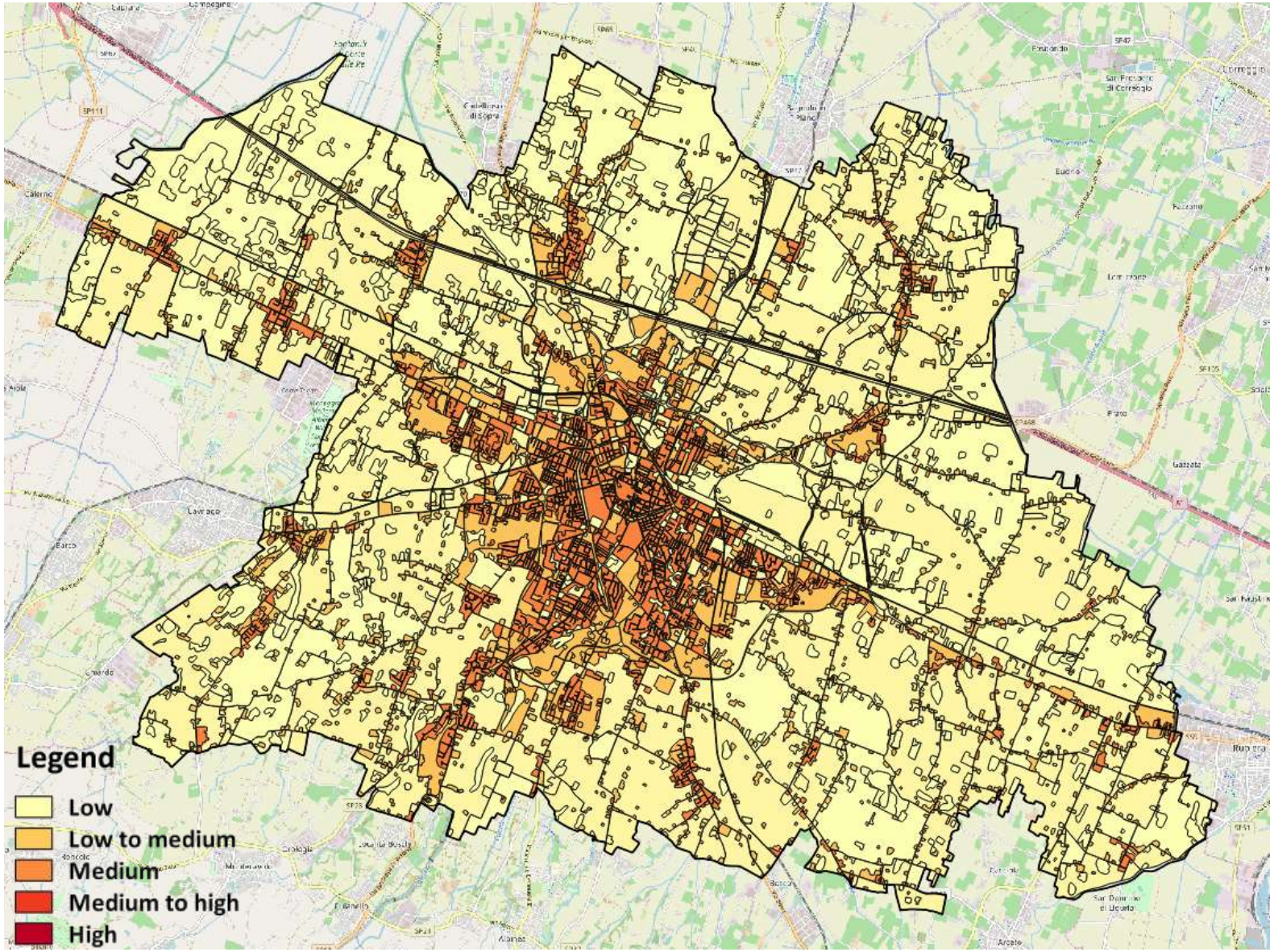
CLASS	AREA (%)
2: Low to medium	50
3: Medium	16
4: Medium to high	34



HEATWAVES AND HEALTH – REGGIO EMILIA

REFERENCE PERIOD

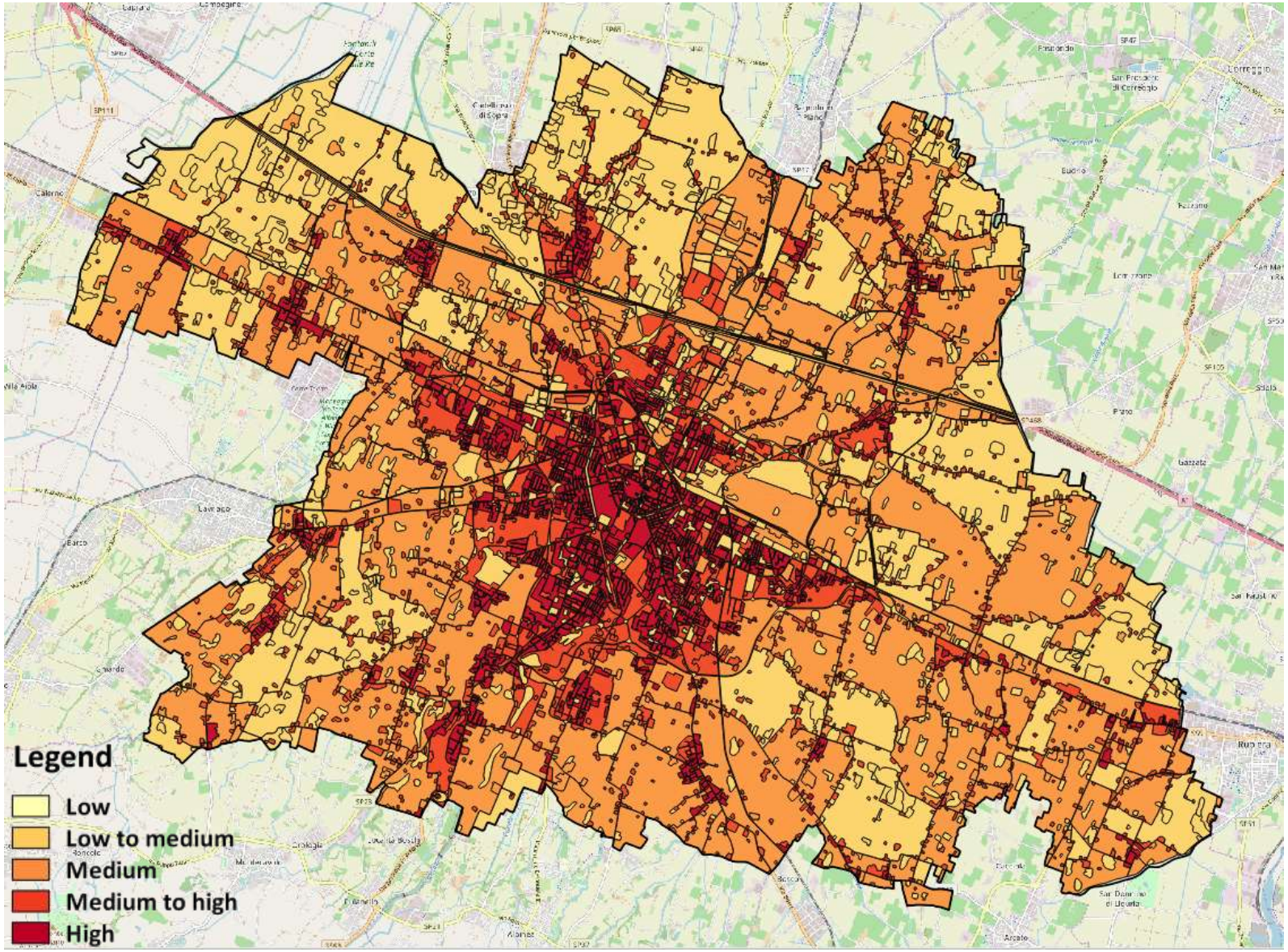
CLASS	AREA (%)
1: Low	79
2: Low to medium	12
3: Medium	9



HEATWAVES AND HEALTH – REGGIO EMILIA

FUTURE PERIOD – RCP 4.5 & RCP 8.5

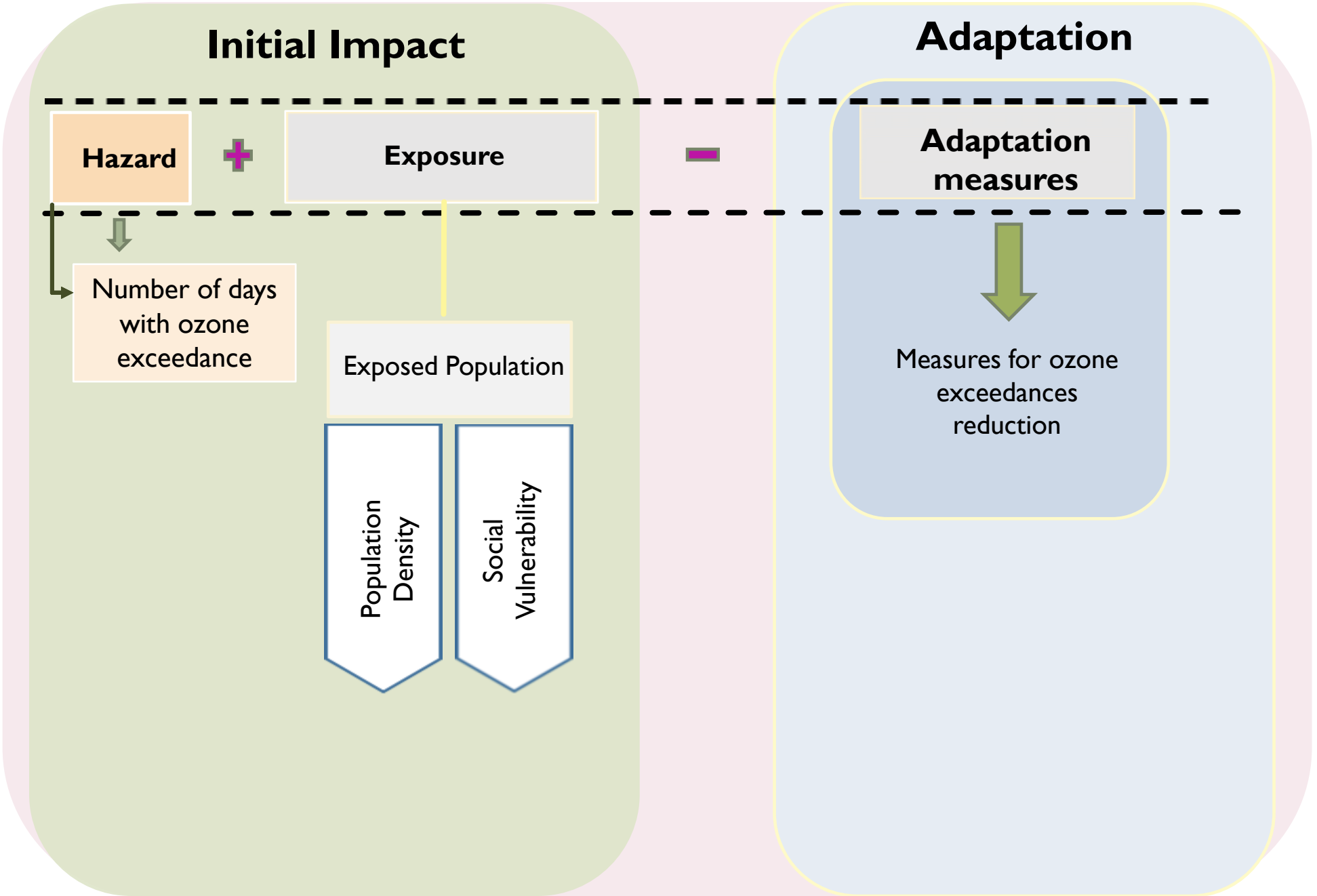
CLASS	AREA (%)
2: Low to medium	36.2
3: Medium	43.2
4: Medium to high	12.1
5: High	8.5



OZONE EXCEEDANCES

- The impact of ozone exceedances is conceived as a function of climate change hazards and the vulnerability of the exposed population.
- For the assessment of ozone exceedances, the number of days with ozone exceedances above the threshold value for protection of human health, was used for the assessment of the climatic hazard.
- The threshold value of ozone exceedance is 8-hour average ozone concentration above 120 μg/m3
- The vulnerability of the exposed population was estimated based on the composite Social Vulnerability index and the population density.
- The implementation of adaptation measures addressing ozone exceedances is considered to reduce impact.

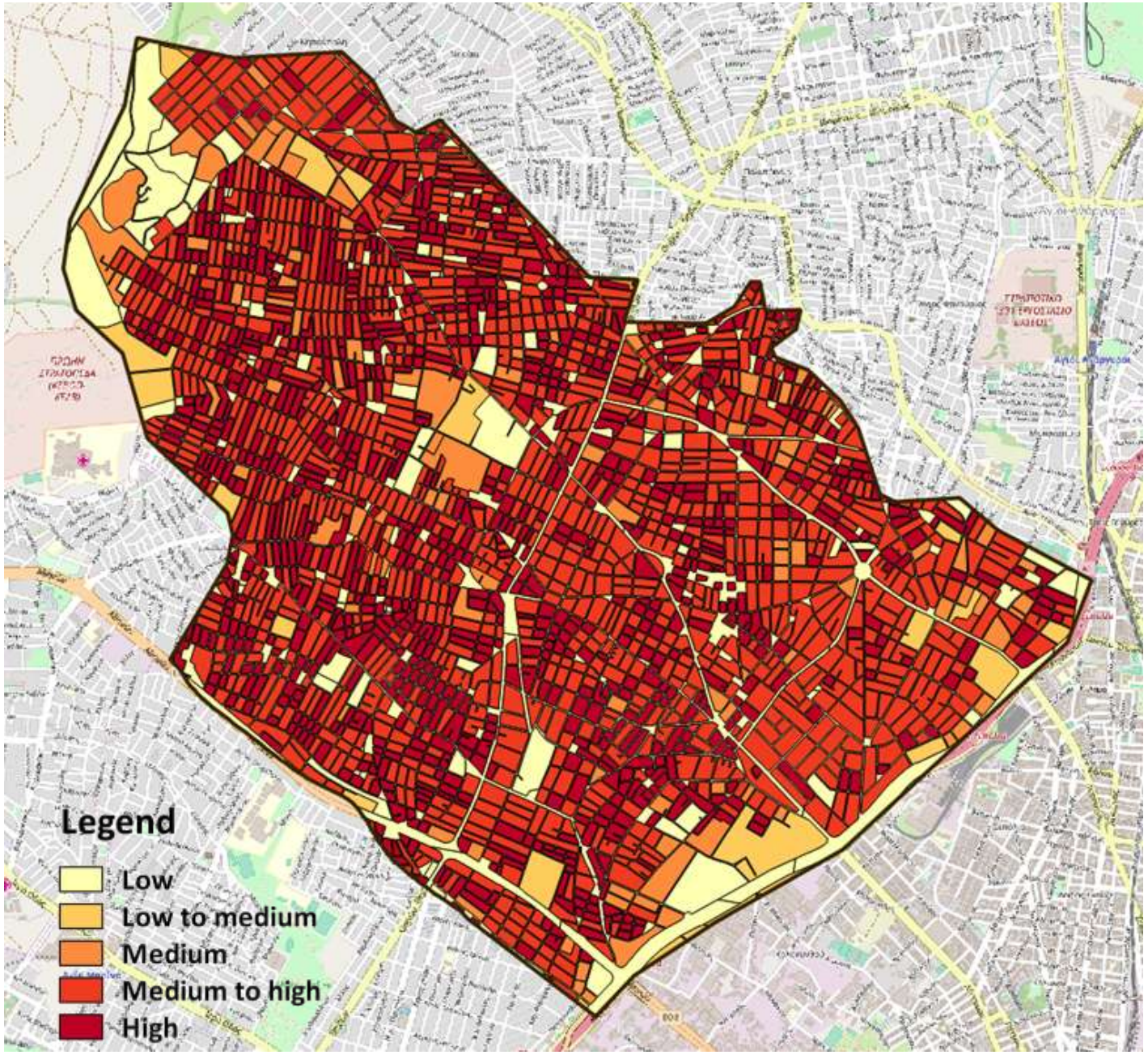
OZONE EXCEEDANCES IMPACT ASSESSMENT



OZONE EXCEEDANCES – PERISTERI

REFERENCE PERIOD

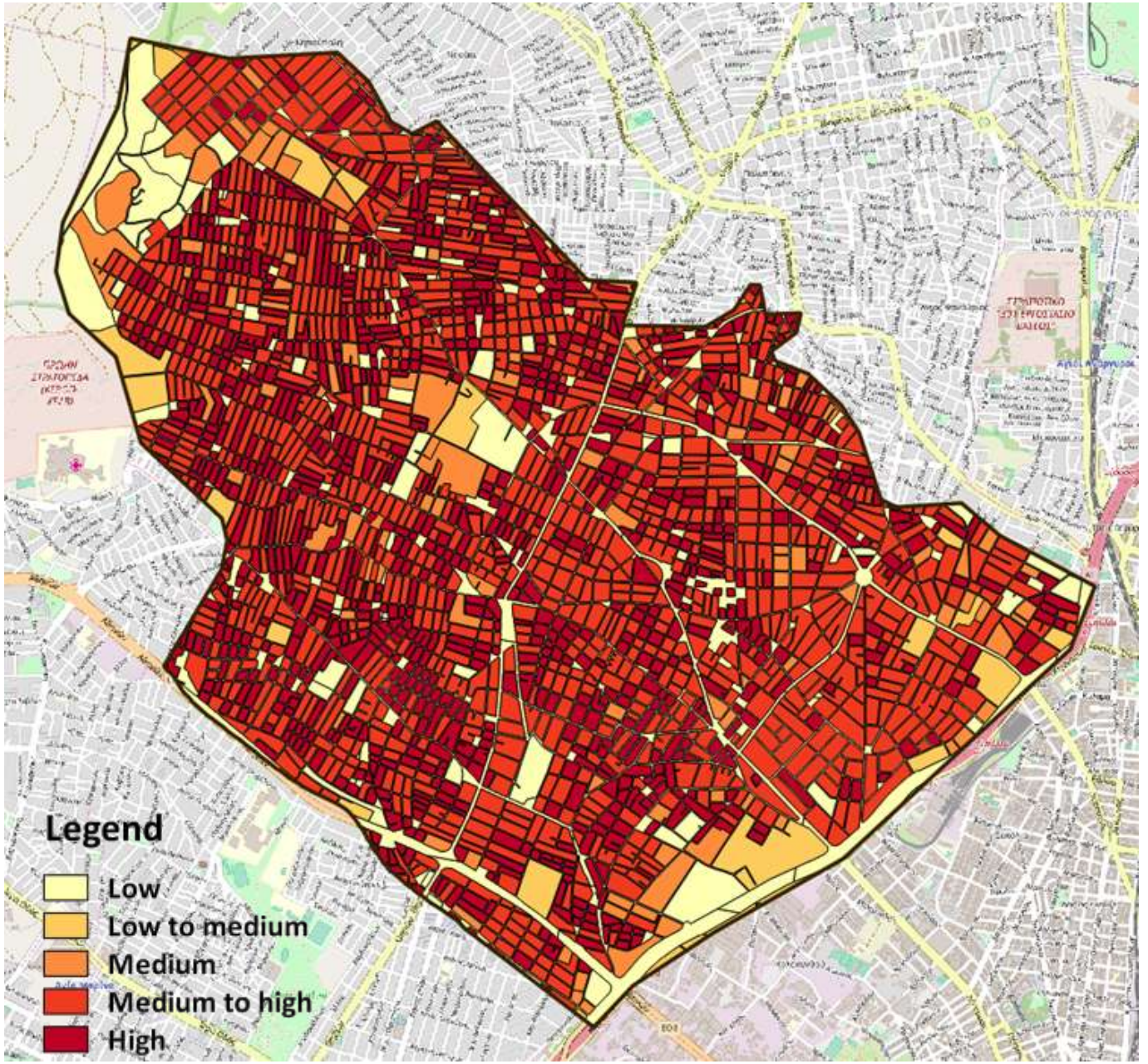
CLASS	AREA (%)
1: Low	28.3
2: Low to medium	3.8
3: Medium	6.6
4: Medium to high	40
5: High	21.3



OZONE EXCEEDANCES – PERISTERI

FUTURE PERIOD – RCP 4.5 & RCP 8.5

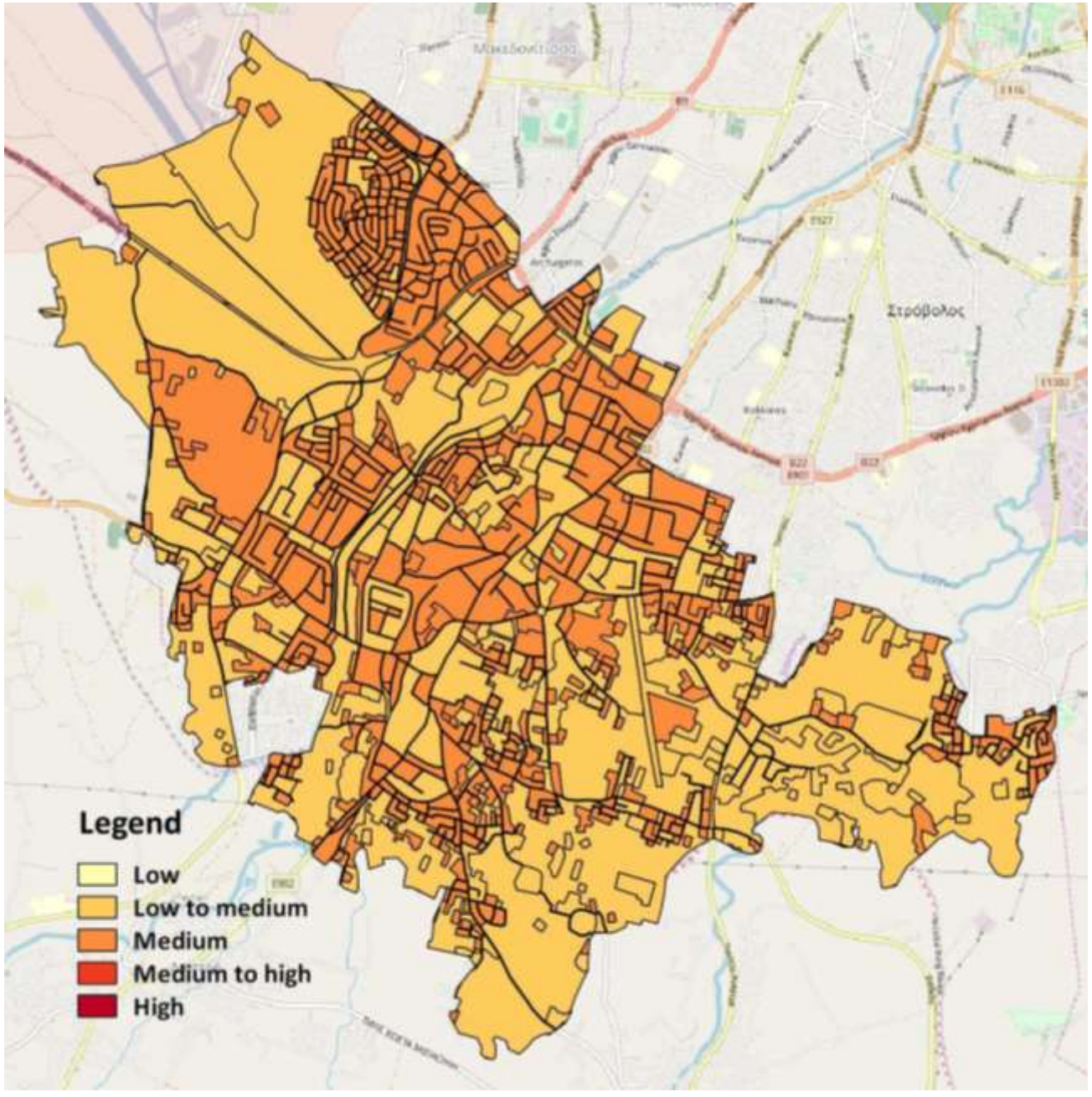
CLASS	AREA (%)
1: Low	28.3
2: Low to medium	3.8
3: Medium	6.6
4: Medium to high	40
5: High	21.3



OZONE EXCEEDANCES – LATATAMIA

REFERENCE PERIOD

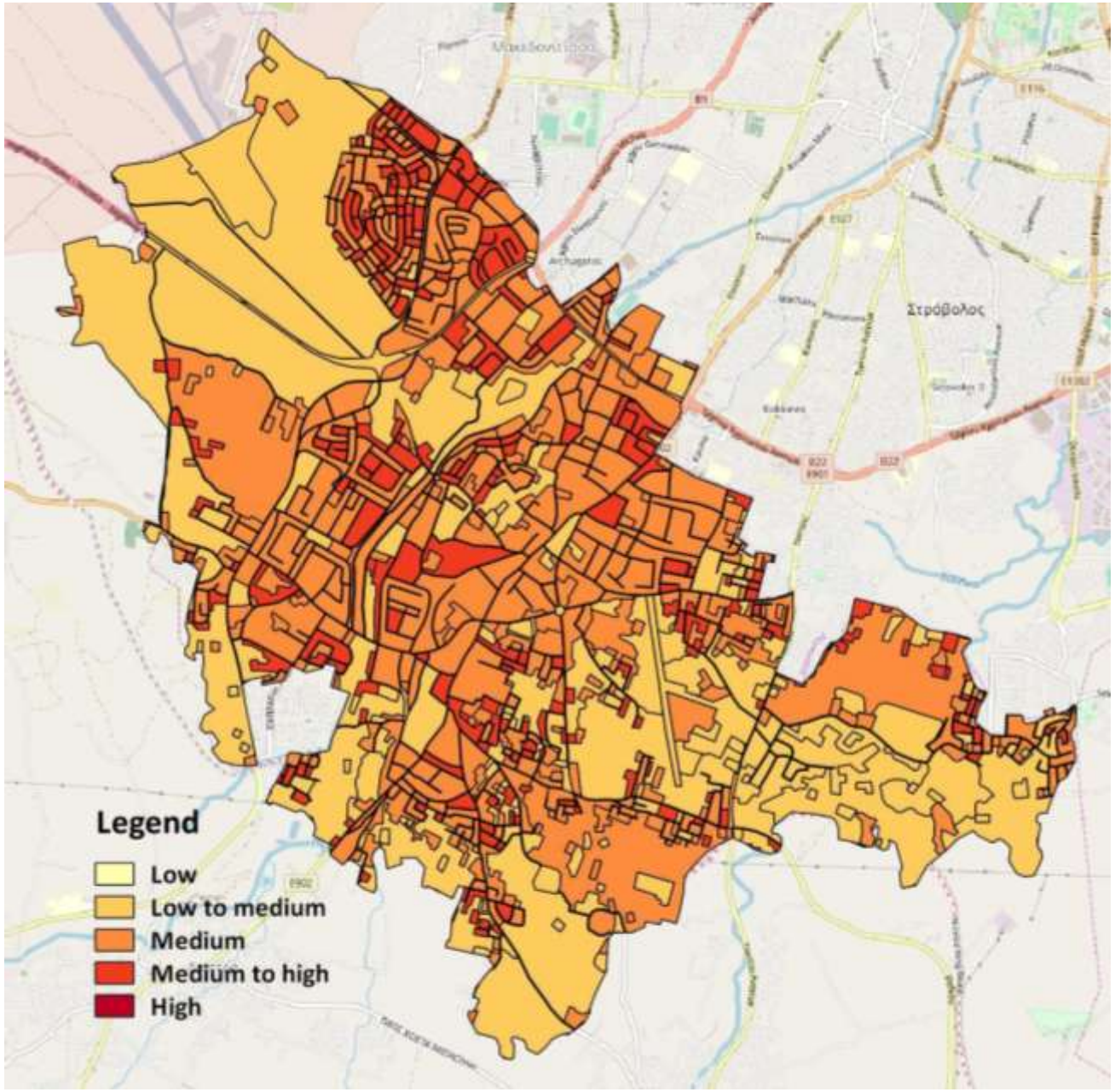
CLASS	AREA (%)
2: Low to medium	66
3: Medium	34



OZONE EXCEEDANCES – LATATAMIA

FUTURE PERIOD – RCP 4.5 & RCP 8.5

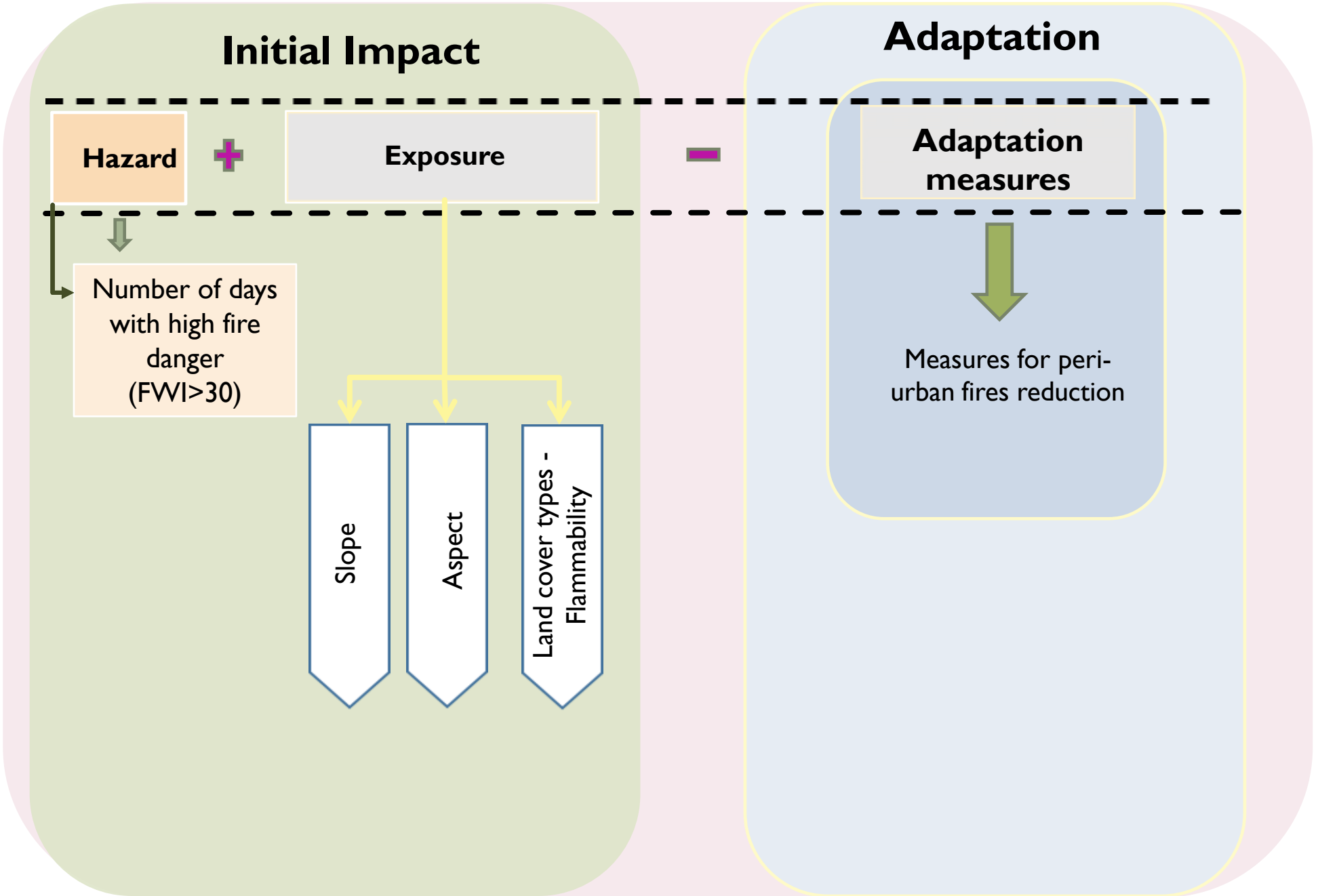
CLASS	AREA (%)
2: Low to medium	50
3: Medium	41
4: Medium to high	9



PERI-URBAN FIRES

- For the assessment of peri-urban fires, the Fire Weather Index (FWI) was used for the assessment of climatic hazard
- FWI is a meteorologically -based index used to estimate fire danger based on temperature, relative humidity, wind speed and precipitation.
- In specific, the expected number of days with (FWI) above 30 (i.e. days with high fire danger) was used for the assessment.
- Other parameters of relevance for the assessment were also used, i.e. slope, aspect and land cover flammability.

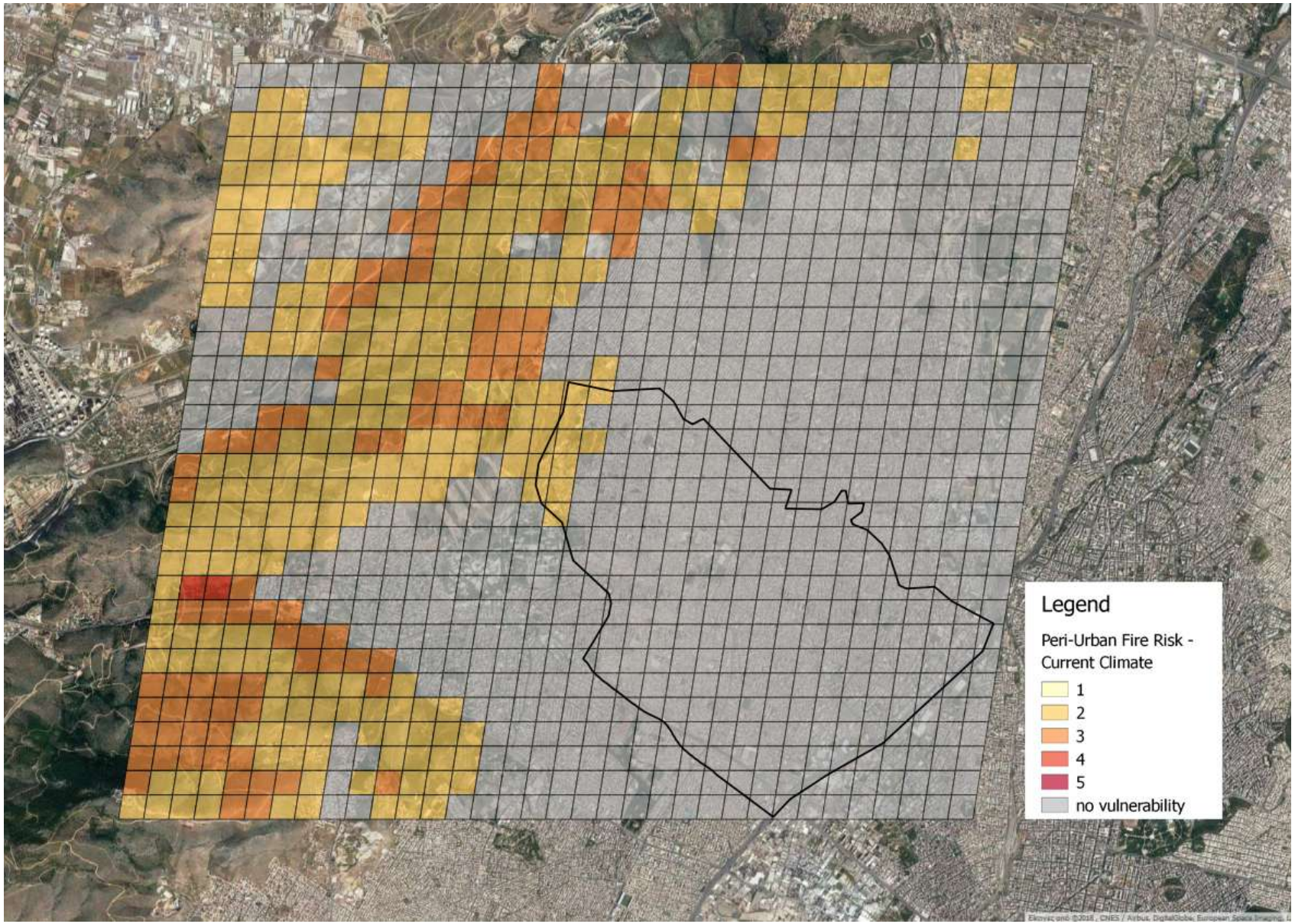
PERI-URBAN FIRES IMPACT ASSESSMENT



PERI-URBAN FIRES – PERISTERI

REFERENCE PERIOD

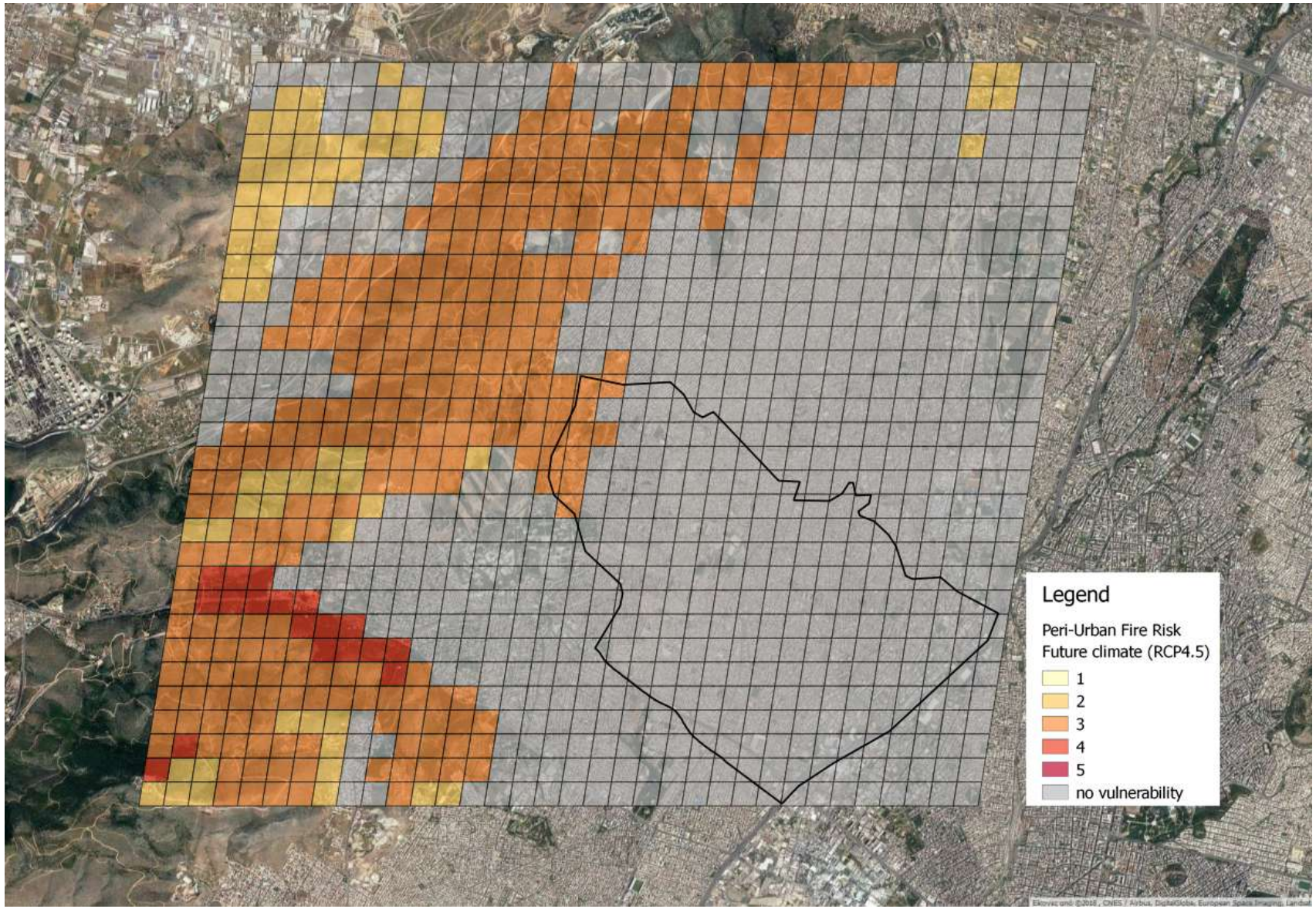
CLASS	AREA (%)
0: No impact	66
2: Low to medium	25
3: Medium	9
4: Medium to high	0,2



PERI-URBAN FIRES – PERISTERI

FUTURE PERIOD – RCP 4.5 & RCP 8.5

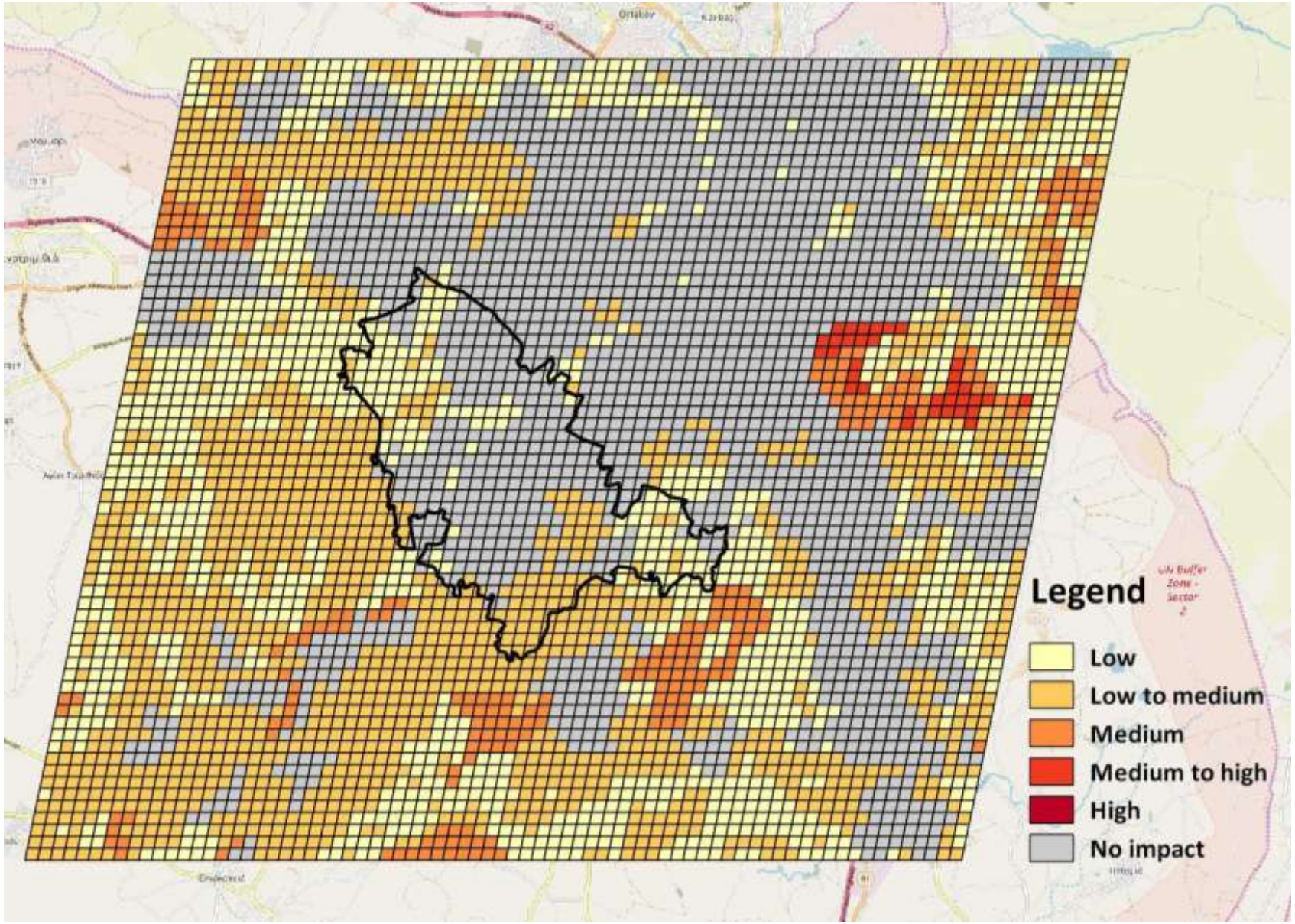
CLASS	AREA (%)
0: No impact	66
2: Low to medium	6,5
3: Medium	25,8
4: Medium to high	1,7



PERI-URBAN FIRES – LATATAMIA

REFERENCE PERIOD

CLASS	AREA (%)
No impact	38
1: Low	24
2: Low to medium	32
3: Medium	5
4: Medium to high	1



PERI-URBAN FIRES – LATATAMIA

FUTURE PERIOD – RCP 4.5 & RCP 8.5

CLASS	AREA (%)
No impact	38
2: Low to medium	45
3: Medium	15
4: Medium to high	2