



ENSURE E-LEARNING TOOL

F42_Applying the ENSURE methodology for vulnerability assessment: the case of Ilia forest fires

Presentation

Application of the ENSURE methodology to the forest fire HAZARD: Case study of Ilia, Greece

by E. Karymbalis, M. Varympopiotou and K. Sapountzaki
ENSURE final meeting





**ENSURE FINAL CONFERENCE MEETING
ORLEANS, FRANCE
10-11 MAY 2011**



***“APPLICATION OF THE ENSURE METHODOLOGY TO
THE FOREST FIRE HAZARD: CASE STUDY OF ILIA,
GREECE”***

E. Karymbalis⁽¹⁾, M. Varympopiotou⁽²⁾ and K. Sapountzaki⁽³⁾

(1) Department of Geography, Harokopio University, 70 El. Venizelou Str. 176 71 Athens, email: karymbalis@hua.gr

(2) Department of Geography, Harokopio University, 70 El. Venizelou Str. 176 71 Athens, email: varympopiotou@yahoo.com

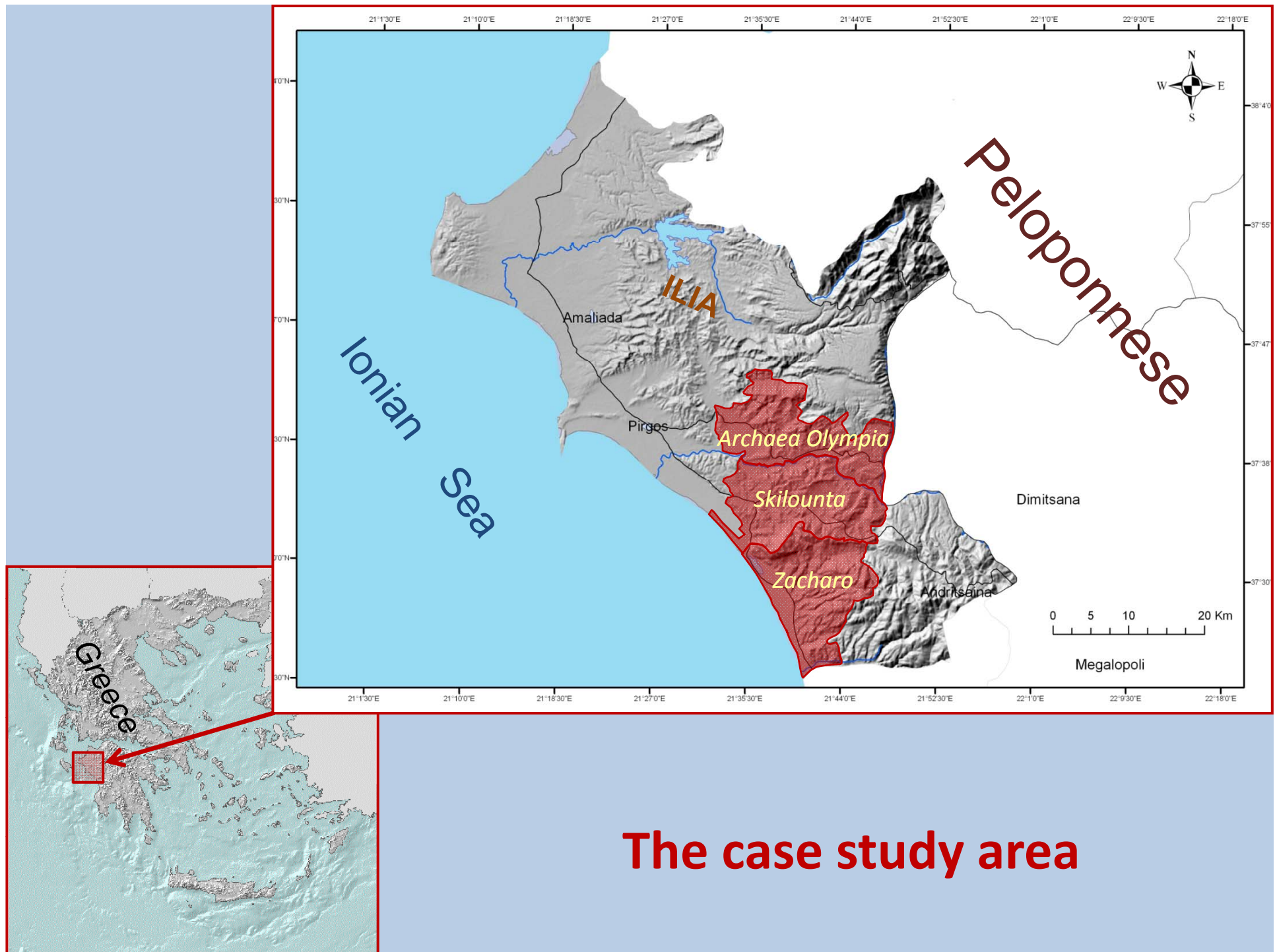
(3) Department of Geography, Harokopio University, 70 El. Venizelou Str. 176 71 Athens, email: sapountzaki@hua.gr

The main idea of the Ensure Project

- To propose a new method to assess in an integrated manner the various aspects of Vulnerability and Resilience to the several hazards and all along the disaster cycle.
- To provide a comprehensive and structured tool to assess communities' vulnerability at regional and local level by addressing the basic carrying systems (natural environment, built environment, infrastructure-production sites and social systems) and taking into account both structural and non-structural conditions and measures.

Aim of the presentation

- The presentation deals with integration of the several aspects of vulnerability/resilience to forest fire of the various systems carrying it throughout a specific disaster cycle, that of Iliia Mega-fires of 2007, Peloponnese, Greece.
- To present the methodology implementation process in the case of forest fires in Iliia Prefecture, (joint application by HUA and PIK).
- Also to refer to advantages and disadvantages of the methodology out of its application to the Greek case study area.



The case study area

The Prefecture of Ilia

- Covers an area of 2,681 km².
- It is divided into 22 Municipalities.
- Its population amounts 193,288 inh.
- Retains population of productive ages. constant (i.e. 15-64 years of age) but loses population of young ages (i.e. up to 14 years).
- The human resources and socio-economic structures are bedeviled by:
 - ❖ the unilateral development of the primary sector,
 - ❖ low competitiveness of the local agro-food products,
 - ❖ sensitivity of agricultural production to price fluctuations,
 - ❖ small size of agricultural lots,
 - ❖ unemployment and low education levels,
 - ❖ population ageing,
 - ❖ low GDP per capita,
 - ❖ lack of public welfare facilities,
 - ❖ lack of infrastructure to support the use of advanced technologies.



The integrated approach consists of a set of four matrices:

First Matrix: Resilience - Mitigation capacity

Second Matrix: Physical vulnerability - Vulnerability to stress (hazard)

Third Matrix: Systemic vulnerability - Vulnerability to losses

Fourth Matrix: Resilience - response capability in the long run

The approach takes into account both structural and non-structural conditions and measures concerning the basic carrying systems:

Natural environment

Built environment

**Infrastructure and
production sites**

Social system (agents)

Methodology implementation process

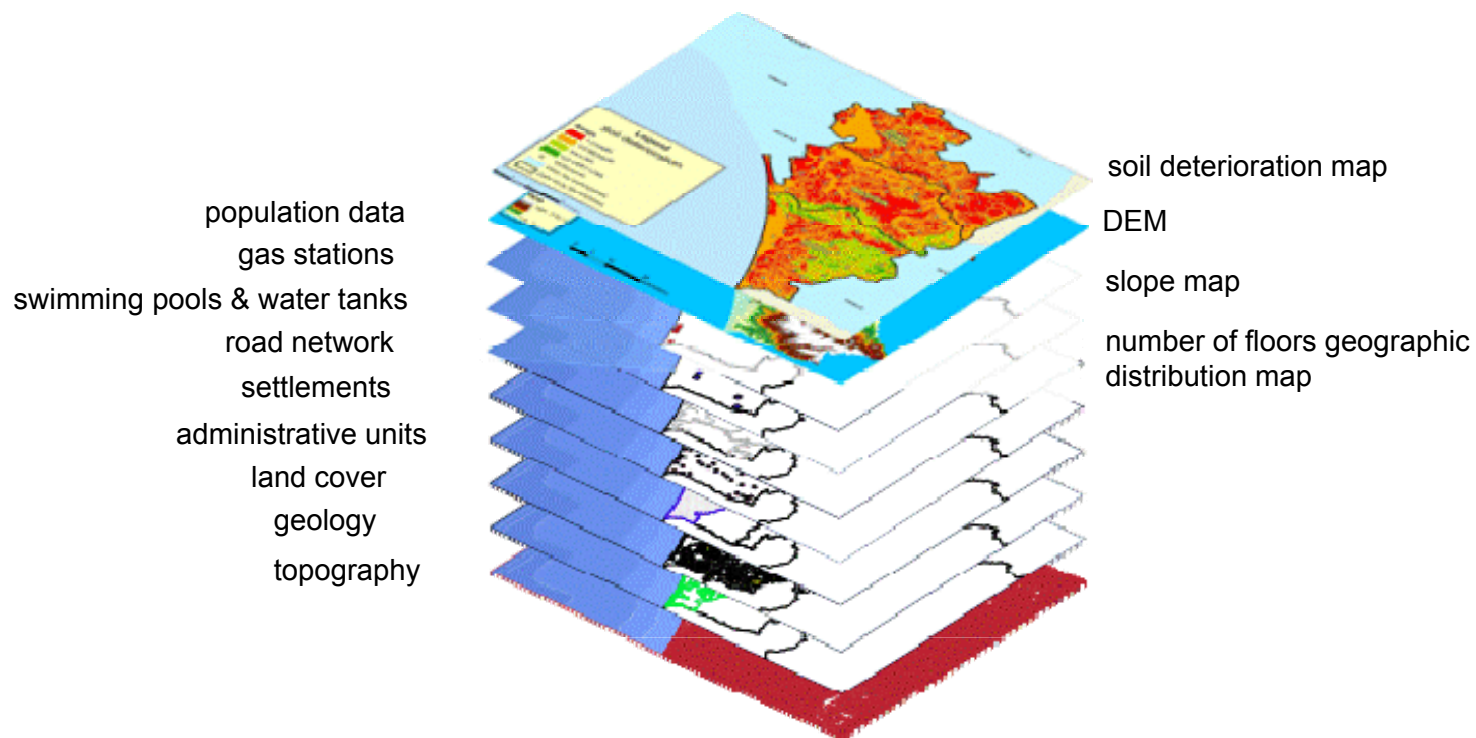
First stage

- The first stage included collection of and filling the data which are relevant to the provided parameters.
- This was possible by appealing to primary and secondary data sources.
- In some cases information was obtainable only by means of ad-hoc surveys or studies since these were not available.
- In several cases collection of information presupposed appealing to the responsible authorities (at the regional and local level).
- Data for the Ilia case study have been processed by:
 - (a) organizing appropriate data bases and digitizing maps and
 - (b) interpreting material out of interviews with public officials at the local and regional level and competent staff of Public Utility Companies. Questions have been addressed to central state agencies, public officials working at the Municipality, the Forest Service, and the Public Power Corporation.

Methodology implementation process

First stage

- For some parameters the creation of maps through GIS techniques was necessary in order to represent spatial variations and visualise the results.



Methodology implementation process

Second stage

- The second stage was attributing values to the parameters, filling the descriptor column and attributing score to vulnerability.
- Vulnerability scores for each parameter ranged between 1–high & 5–low.

Methodology implementation process difficulties

- Assessment of some of the proposed parameters was difficult because of the absence of consolidated public databases (digitalised maps of the area, hazard maps, risk maps, etc).
- Therefore, collection and processing of information has been a long process.
- Distinct authorities had different views regarding certain parameter cases.
- In some cases reliability of the responsible authorities' answers was questionable due to the fact that public officials are in a position to defend their role and present an ideal situation of their authority.
- For some parameters vulnerability scoring relied –to a certain degree- on subjective judgements.
- It was found that local conditions and peculiarities (ecological, administration etc) made some parameters irrelevant and called for some extra parameters. For instance, the parameters of the built environment match urban and not rural areas as is the case of the Ilia Municipalities under consideration.

Methodology implementation process difficulties

- Several parameter values varied enormously between the pre- and post-disaster stage (the case of Ilia has been an actual disaster but it has not been clear from the beginning whether the first matrix about the mitigation phase should refer to the pre-fire conditions in Ilia or to those after recovery).
- Several parameter values varied significantly from one sub-area to another (i.e. in spatial terms) and it was not clear whether we should take into account the average parameter value, the maximum, the minimum or other.

First Matrix: Resilience: Mitigation capacity

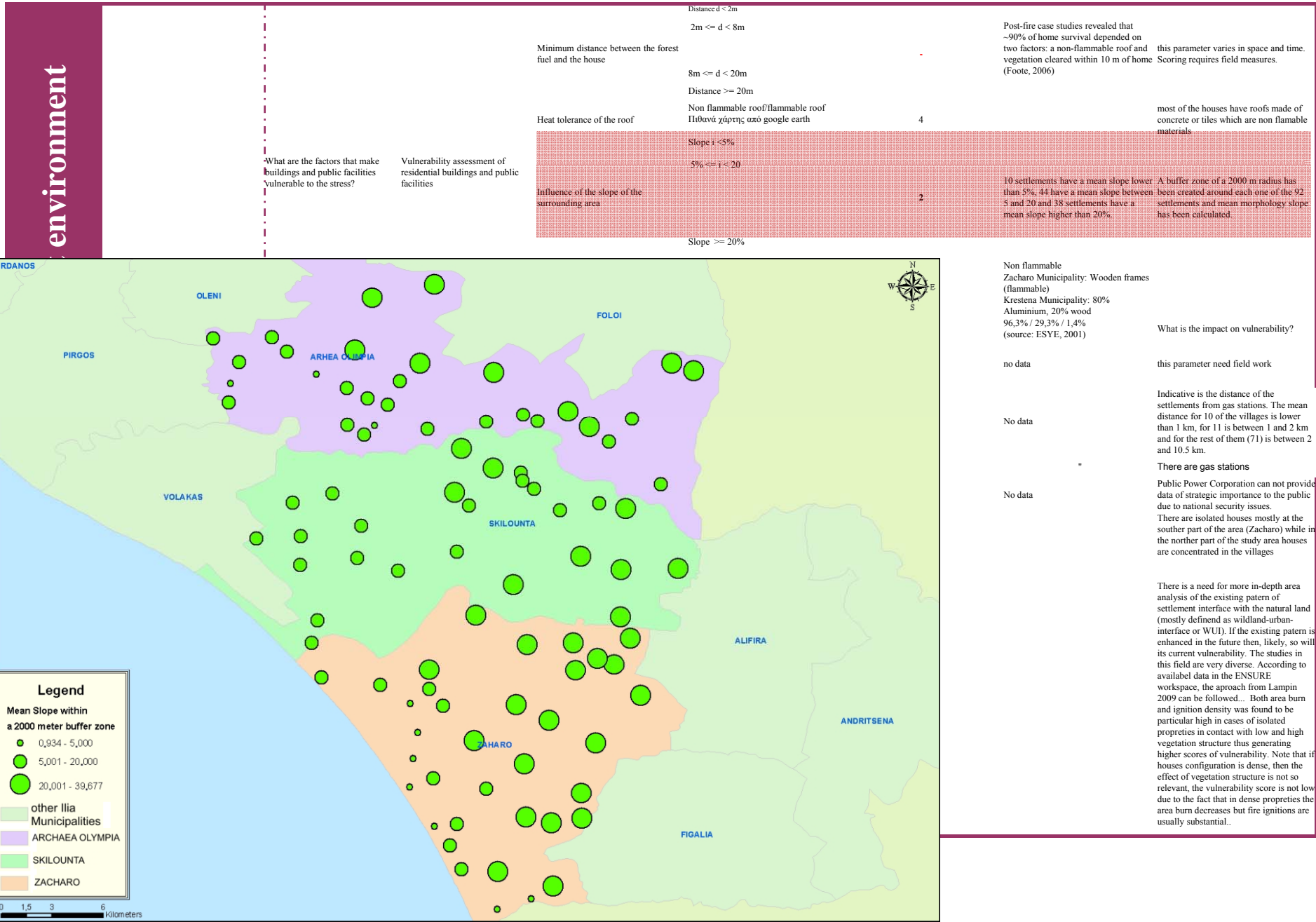
	System	Aspect	Parameters	Criteria for assessment	Descriptors	Vulnerability scoring 1 (high) - 5 (low)	Descriptive comments for judging vulnerability	Remarks
Natural environment	Natural Hazards	Are natural hazards known and mapped?	Hazard maps availability	Maps of areas prone to fires; map of inflammability of vegetation	yes/no; quality as judged with respect to international standards	2	NO (not in relation to phytoclimatic maps and land uses)	
			Do hazard assessment consider climate change	binary	yes/no	1	NO	
		Is available knowledge updated?	Hazard maps updating	Frequency of updating	every 2 years and after each event/rarely	2	NO	
		Are hazards monitored?	Existence, distribution and quality of monitoring networks	technical monitoring systems linked to operation centre	yes/no	4	YES (daily during the fireprone period of the year)	
				permanent staff dispaced in critical areas for direct monitoring and immediate intervention	yes/no	2	In a few cases	
		Are monitoring systems connected to forecasting modelling systems?	Availability, quality of early detection systems and models	binary; quality of early detection and propagation estimation models	yes/no; models tailored to the geographical context/not tailored	1 (?)	Detection systems were available before the forest fire, but according to the personal view of the Forest Head Officer, these were useless. The fire brigade claims that such a system does not exist.	Conflict of views between responsible agencies
		structural defence measures	Existence of defenses for breaking the fire lines	binary	yes/no	2	YES, but existing fire break zones proved to be useless because these did not match the operational plans laid out by the Fire Brigade and The Fire Service	Difficult to assess vulnerability

Built environment	Exposure and vulnerability of built environment	Is exposure and vulnerability considered and acted upon in plans?	Vulnerability assessment of exposed built stock	binary; updating frequency	yes/no; every time new building permits are given/only occasionally	1	NO	
			Risk maps and scenarios, including enchain events	binary; year of production	yes/no	1	NO	
			Vulnerability and exposure assessment considered in ordinary plans (example land use)	binary; mode of inclusion	yes/no; only formally/substantially with limitations and specific requirements	1	NO	
	Rules and tools for risk mitigation	Do rules for mitigation exist? What is their expected efficacy/quality?	Building codes/rules	binary; updated	yes/no; rules efficacy checked after each event/rarely tested	1	NO	
			Property regime of houses	owned houses versus tenants	owners own < 50% / own > 80%	4	>80%	What is actually the impact on vulnerability?
			Traditional building practice based on hazard knowledge	binary; capacity to re-produce traditional techniques correctly	yes/no; judgement about the capacity to conform to the "code of practice"	1	NO	
			Maintenance of fire suppression devices and clearing vegetation around houses	binary	yes/no	4	YES	
			Land use plans embedding risk mitigation and vulnerability reduction	binary; specific indications for vulnerable locations	yes/no; specific rules for the wildland-urban interface and for accessibility	1	NO	
			Implementation capacity	binary; frequency of inspections; trained personnel for inspections	yes/no; every year/seldom	-	Irrelevant	
			Integration to other measures (insurance)	binary	yes/no	-	Irrelevant	

Infrastructure and production sites	Critical infrastructures	Is vulnerability of critical infrastructures assessed and acted upon? Particularly with respect to na-techs and enchain effects on depending systems?	Vulnerability assessment of critical infrastructure	binary, particularly for roads and water for firefighting	yes/no	1	NO	
			Maintenance programs embedding mitigation	binary	yes/no	-	Irrelevant	
			New projects based on hazard/risk assessment	binary	yes/no	-	Irrelevant	
			Level of coordination among stakeholders	degree	low/medium/high	4	Medium to high level of coordination, there is a plan for protection specialized for this purpose	
	Production sites	Is the vulnerability of production sites considered particularly with respect to potential na-techs?	Vulnerability assessment of production sites to wildfire	binary	yes/no	-	No data	Public Power Corporation can not provide data of strategic importance to the public due to national security issues.
			Retrofitting measures for existing production sites	binary	yes/no	-	No data	Public Power Corporation can not provide data of strategic importance to the public due to national security issues.
			New projects based on risk assessment	binary	yes/no	-	No data	Public Power Corporation can not provide data of strategic importance to the public due to national security issues.
			Na-tech explicitly accounted for in hazardous installations emergency plans	binary	yes/no; expert judgement on quality	-	No data	Public Power Corporation can not provide data of strategic importance to the public due to national security issues.

Social system (agents)	People/individuals	Parameters are addressed to evaluate the capacity of individuals living in prone hazard areas of coping with hazardous events, which largely depends on the perception and awareness of risk conditions before the event occurs.	Risk perception/ awareness	Degree	strong/average/low	2 (?)	Average	There is a need for conducting a special study. How does this influence vulnerability?
			Reliance on institutional firefighting capabilities	Degree	strong/average/low	2	Strong reliance	AVERAGE, Some volunteers available in every settlement.
			Felt responsibility for firefighting and fire mitigation	Degree	strong/average/low	2		
			Individual preparedness	regarding specific self protective measures; regarding measures included in emergency plans	hydrant available/not available;	4	Hydrants available	
					escaping routes known/not considered	1		Escaping routes are a wrong parameter in the case of fires. The solution is to gather at the center of the village. No escaping routes, but -if existing- misleading. Hence, how to assess vulnerability?
	Community and Institutions	Parameters are addressed to evaluate the involvement of a community into decision-making processes related to risk prevention and mitigation, the capacity of Institutions of improving risk awareness through information and education campaigns and the level of cooperation among different institutions in charge of risk prevention/ mitigation.	Participation in development and prevention/mitigation strategies	degree	strong/medium/low	2	LOW participation. It is questionable whether the information material reaches the citizens and if the latter show any interest.	Zacharo Municipality: Brochures and information provided by the Civil Protection before and after the fire event Krestena Municipality: Brochures and information provided by the Civil Protection at a prefectural and local level.
			Education programs & media campaigns	binary; frequency	yes/no; every year/only seldom	2	NO	Only after the last event
				tailored to the community features	yes/generic	1	NO	
			Economic access to resources for firefighting	Inclusion in school programs	yes/no	1	NOT YET	
				degree	very low/low/average/high	3	NO ACCESS before the disaster event. High access after Zacharo Municipality: No fire trucks before the fire event, one donated by private individuals after the fire event but not used Krestena Municipality: No fire trucks before the fire event, five after the event donated by the National Bank and the Australian Club	There is a question on how parameter fluctuation before and after the event can be represented The parameter and scoring varies largely before and after the event
			Coordination and cooperation among institutions in charge of risk prevention/ mitigation	degree	strong/medium/low	2	LOW - Low level consensus between the Forest Service and the Fire Brigade for the development of forest roads	

Second Matrix: Physical vulnerability:
Vulnerability to stress (hazard)



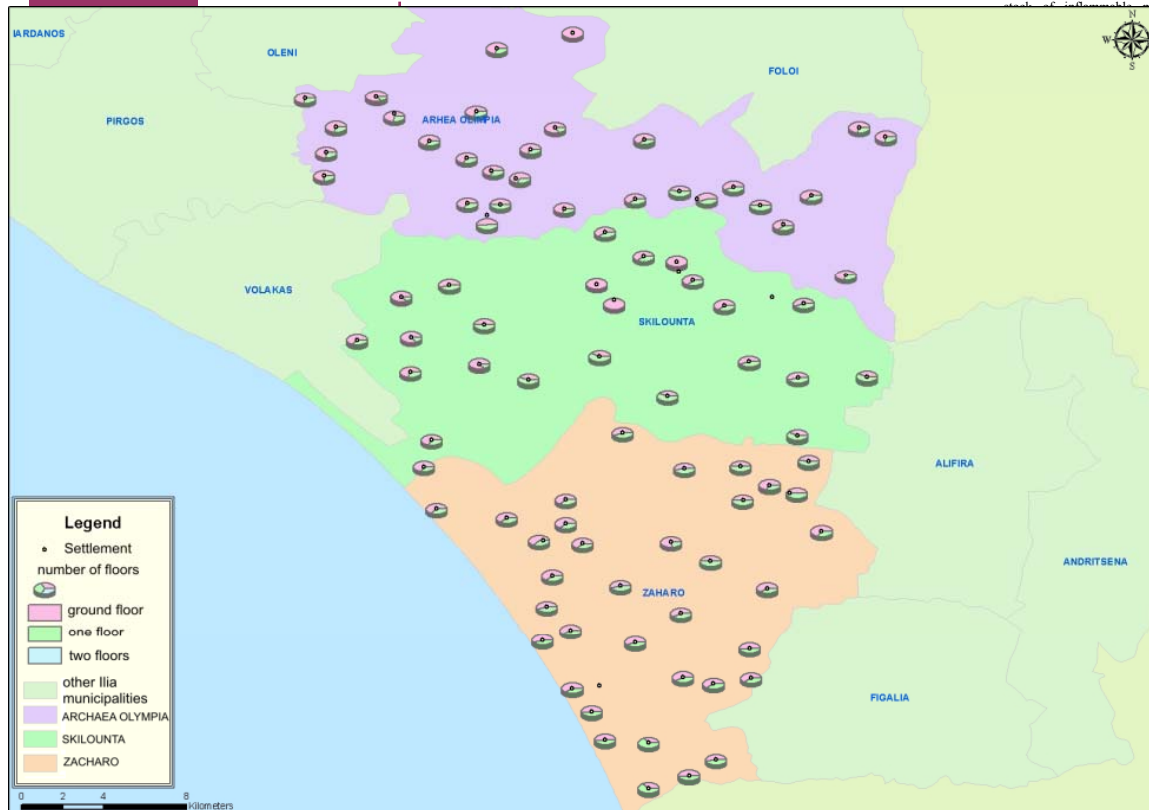
Second Matrix: Physical vulnerability: Vulnerability to stress (hazard)

Built environment

What are the factors that make buildings and public facilities vulnerable to the stress?

Vulnerability assessment of residential buildings and public facilities

Minimum distance between the forest fuel and the house	Distance $d < 2m$ $2m \leq d < 8m$ $8m \leq d < 20m$ Distance $\geq 20m$???	Post-fire case studies revealed that ~90% of home survival depended on two factors: a non-flammable roof and vegetation cleared within 10 m of home (Foote, 2006)	this parameter varies in space and time. Scoring requires field measures.
Heat tolerance of the roof	Non flammable roof/flammable roof Πυθανά χάρτης από google earth Slope $i < 5\%$ $5\% \leq i < 20$	4	No data	most of the houses have roofs made of concrete or tiles which are non flammable materials
Influence of the slope of the surrounding area	Slope $\geq 20\%$	2	10 settlements have a mean slope lower than 5%, 44 have a mean slope between 5 and 20 and 38 settlements have a mean slope higher than 20%.	A buffer zone of a 2000 m radius has been created around each one of the 92 settlements and mean morphology slope has been calculated.
Heat tolerance of the walls	Non burnable walls/ flammable walls	4	Non flammable	
Heat tolerance of the shutters	Metal shutters/wood or plastic shutters	2	Zacharo Municipality: Wooden frames (flammable) Krestena Municipality: 80% Aluminium, 20% wood	
Number of floors(C4)	Only ground floor/2 floors/ > 2floors		96,3% / 29,3% / 1,4% (source: ESYE, 2001)	What is the impact on vulnerability?



or other al	-	no data	this parameter need field work
lations or	4	No data	Indicative is the distance of the settlements from gas stations. The mean distance for 10 of the villages is lower than 1 km, for 11 is between 1 and 2 km and for the rest of them (71) is between 2 and 10.5 km.
or high electricity	2	"	There are gas stations
to high	-	No data	Public Power Corporation can not provide data of strategic importance to the public due to national security issues.
to high	5		There are isolated houses mostly at the southern part of the area (Zacharo) while in the northern part of the study area houses are concentrated in the villages
	3		
	2		There is a need for more in-depth area analysis of the existing pattern of settlement interface with the natural land (mostly defined as wildland-urban-interface or WUI). If the existing pattern is enhanced in the future then, likely, so will its current vulnerability. The studies in this field are very diverse. According to available data in the ENSURE workspace, the approach from Lampin 2009 can be followed... Both area burn and ignition density was found to be particular high in cases of isolated properties in contact with low and high vegetation structure thus generating higher scores of vulnerability. Note that if houses configuration is dense, then the effect of vegetation structure is not so relevant, the vulnerability score is not low due to the fact that in dense properties the area burn decreases but fire ignitions are usually substantial..

Second Matrix: Physical vulnerability: Vulnerability to stress (hazard)

Built environment

What are the factors that make buildings and public facilities vulnerable to the stress?

Vulnerability assessment of residential buildings and public facilities

Minimum distance between the forest fuel and the house

Distance $d < 2m$
 $2m \leq d < 8m$

???

Post-fire case studies revealed that ~90% of home survival depended on two factors: a non-flammable roof and vegetation cleared within 10 m of home (Foote, 2006)

this parameter varies in space and time. Scoring requires field measures.

Heat tolerance of the roof

Non flammable roof/flammable roof
Πυθανά χάρτης από google earth
Slope $i < 5\%$

4

No data

most of the houses have roofs made of concrete or tiles which are non flammable materials

Influence of the slope of the surrounding area

$5\% \leq i < 20$

2

10 settlements have a mean slope lower than 5%, 44 have a mean slope between 5 and 20 and 38 settlements have a mean slope higher than 20%.

A buffer zone of a 2000 m radius has been created around each one of the 92 settlements and mean morphology slope has been calculated.

Heat tolerance of the walls

Slope $\geq 20\%$

4

Non flammable

Heat tolerance of the shutters

Non burnable walls/ flammable walls
Metal shutters/wood or plastic shutters

2

Zacharo Municipality: Wooden frames (flammable)
Krestena Municipality: 80% Aluminium, 20% wood
96,3% / 29,3% / 1,4%
(source: ESYE, 2001)

What is the impact on vulnerability?

Number of floors(C4)

Only ground floor/2 floors/ > 2floors

-

no data

this parameter need field work

All residential/residential upper floors

4

No data except than gas stations

Indicative is the distance of the settlements from gas stations. The mean distance for 10 of the villages is lower than 1 km, for 11 is between 1 and 2 km and for the rest of them (71) is between 2 and 10.5 km.

2

"

There are gas stations

-

No data

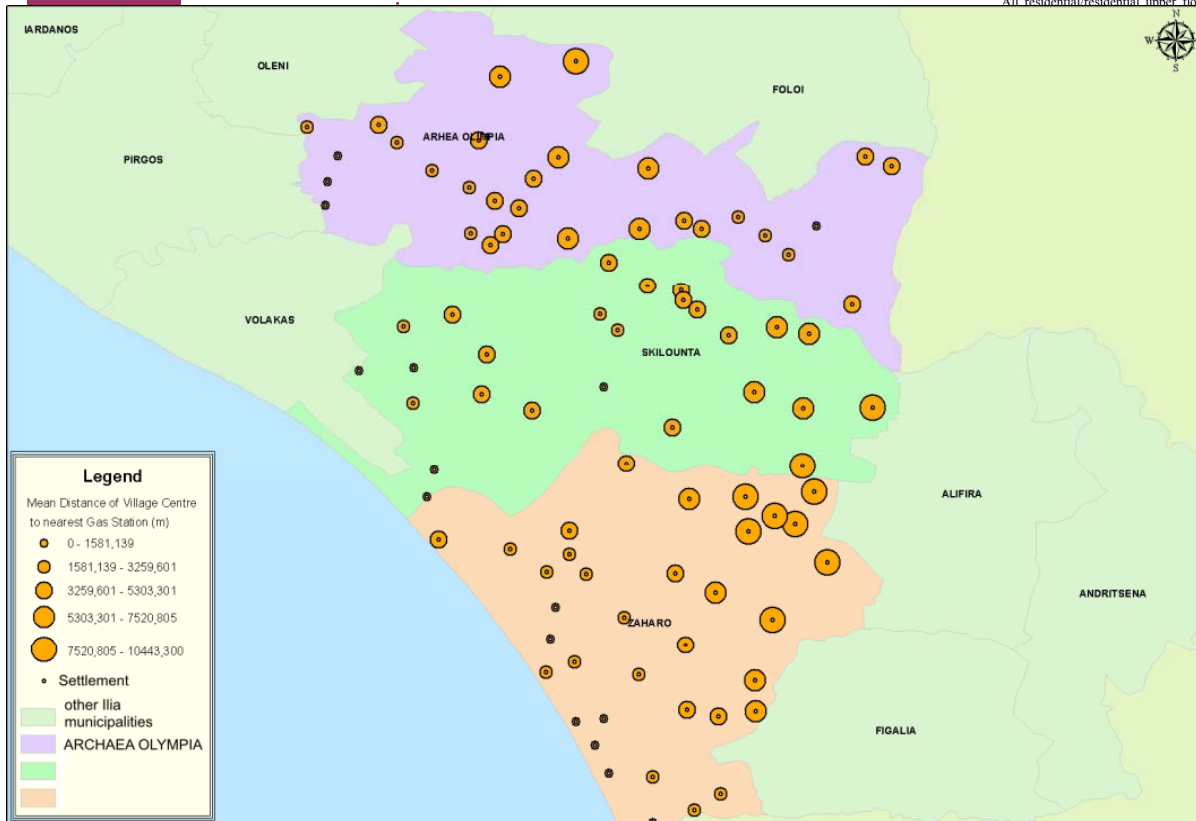
Public Power Corporation can not provide data of strategic importance to the public due to national security issues.
There are isolated houses mostly at the southern part of the area (Zacharo) while in the northern part of the study area houses are concentrated in the villages

5

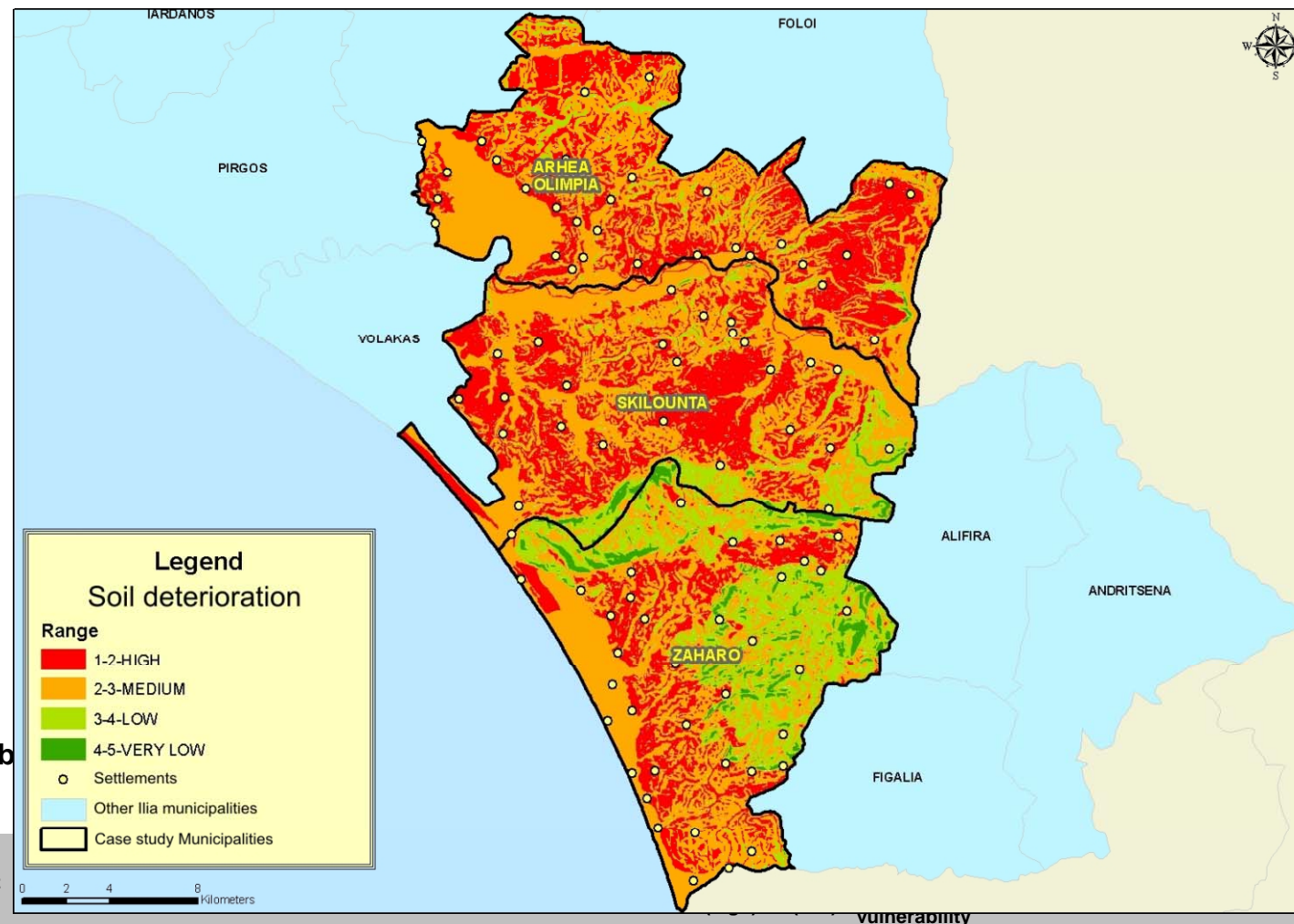
3

There is a need for more in-depth area analysis of the existing pattern of settlement interface with the natural land (mostly defined as wildland-urban-interface or WUI). If the existing pattern is enhanced in the future then, likely, so will its current vulnerability. The studies in this field are very diverse. According to available data in the ENSURE workspace, the approach from Lampin 2009 can be followed... Both area burn and ignition density was found to be particular high in cases of isolated properties in contact with low and high vegetation structure thus generating higher scores of vulnerability. Note that if houses configuration is dense, then the effect of vegetation structure is not so relevant, the vulnerability score is not low due to the fact that in dense properties the area burn decreases but fire ignitions are usually substantial..

2



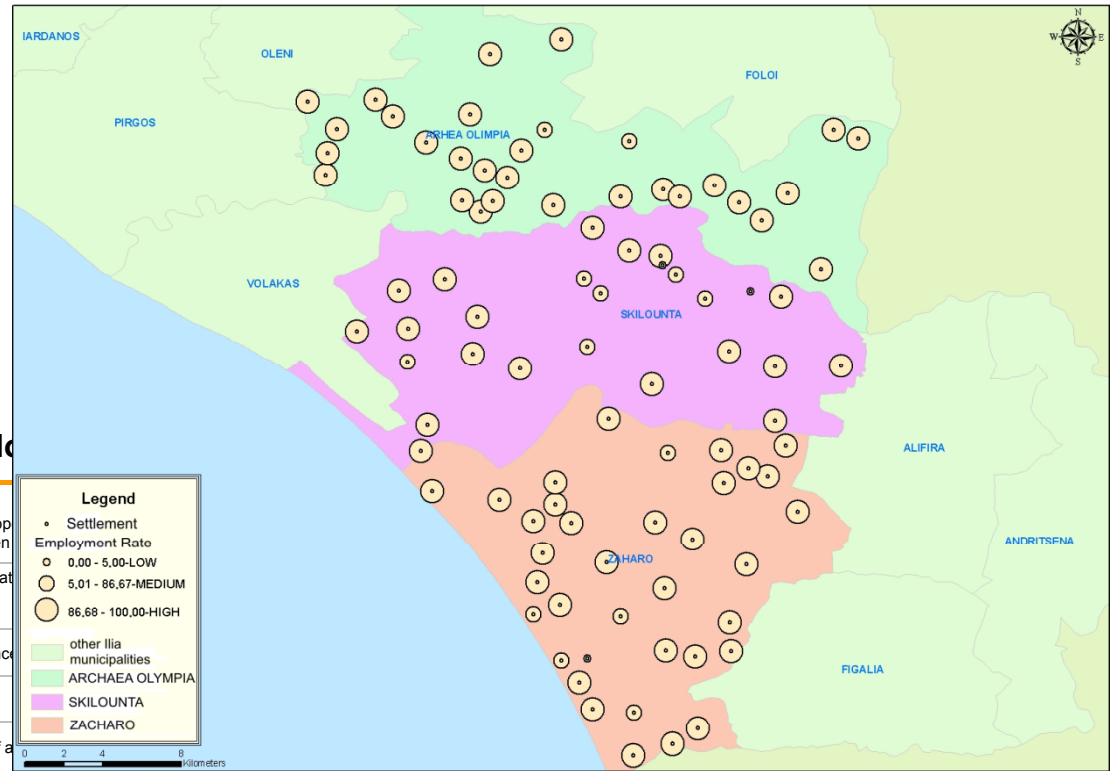
Third Matrix: Systemic vulnerability to losses



Natural environment			vulnerability				
	Natural ecosystems	Are natural ecosystems fragile to the potential secondary effects of hazard(s)?	soil deterioration	increase of erosion	>x%; <= x%	1	A high percentage of the area (71.5, 74.9 and 53.9%) is characterized as of high and very high susceptible to erosion and landslides after a possible fire. These results are in agreement with the results of a study which held after the 2007 fires for the municipality of Zacharo by the EMP.
			landslide hazard	increase of landslide potential (increase of areas with reduced safety factor F)	areas with $F \leq 1$ >> than before the fire	no data	detailed information about the geotechnical properties of the geological formations and elevation data are necessary.

Fourth Matrix: Resilience: response capability in the local

Social system (agents)	People/individuals	Are people in the position to be resilient in the face of a catastrophe?	Availability of psychological support for adults and children	• Settlement				
			Availability of private resources to resettle/repair	Employment Rate	○ 0,00 - 5,00-LOW			
			Access to insurance	○ 5,01 - 86,67-MEDIUM				
			Age structure	○ 86,68 - 100,00-HIGH				
			Local condition of a population	other Iliia municipalities				
				ARCHAIA OLYMPIA				
				SKILOUNTA				
				ZACHARO				
Community	Is the affected community resilient to the consequences of a catastrophe?		Employment rate	degree	high/medium/low			What is exactly the impact on vulnerability?
			Annual population growth rate (over the last five years)	degree	high/medium/low/negative			What is exactly the impact on vulnerability?
			Immigration index	degree	high/medium/low/negative		No data	
			Social networking	degree	high/medium/low/negative	4	High	
			Criminality rate	degree	high/medium/low	4	Low	
			Conflict among social/ethnic groups	degree	high/medium/low	3	Medium	
			Trust in institution	degree	high/medium/low (from sociological surveys when available)	2	Low	
			Transparency in funds allocation	Existence of public information and independent control mechanisms	yes/no	2	NO	
			Long term vision	Existence of strategic development/land use plans	yes/no	1	NO	
			Insurance coverage	binary; coverage	Yes/no;percentage	1	NO	
Economic stakeholders	Are economic stakeholders capable/wishing to reinvest in affected areas?		Dependence of economic actors on loss of environmental goods	Prevalent tourist activity; agricultural activity	percentage	1	HIGH	





Results of the methodology on forest fires (Ilia case study)

- The ENSURE methodology on forest fires allowed for the first time the estimation and visualization of critical VU parameters and scores, mainly those concerning the natural and the built environment, in the case of the most affected by the mega-fires of 2007 municipalities of Ilia.
- First results showed that the most vulnerable systems have been the natural environment and the social system.
- Natural environment appears to be highly vulnerable in the pre-disaster (mitigation) and the physical impact phase where the area is exposed to the hazard (second matrix: vulnerability to stress).
- The social system has been highly vulnerable at the first three phases while during recovery vulnerability has been ameliorated mainly by informal factors such as social cohesion and solidarity, voluntary private donations etc.
- The infrastructure system does not exhibit vulnerability as most of the provided indicators match the case of urban infrastructure and industrial production sites, not rural regions.
- Of the four phases mitigation seems to be the more problematic for all four systems.

Advantages of the methodology (out of its application to Ilia and the forest fire hazard)

- It is a realistic approach of vulnerability/resilience as an analytical background for the formulation of risk management solutions representing measures which balance the engineers', social scientists', physical geographers' and managers' point of view.
- The proposed determinant parameters are manageable. The steps to be followed for obtaining usable data are clearly identified and in most of the cases are described in such a way that an end-user who has not participated in the research is able to apply the method on his/her own.
- The method is characterized by transparency of the assessment process.

Advantages of the methodology (out of its application to Ilia and the forest fire hazard)

- It is flexible enough to enable future developments in research and practice that can be easily incorporated in without significant changes in the whole structure of the method.
- It faces the forest fire risk problem from a holistic point of view, i.e. with respect to its physical and geographical aspects, human accountabilities and causes and the pertinent in each area administrative particularities (weaknesses and strengths).

Advantages of the methodology (out of its application to Ilia and the forest fire hazard)

- It captures parameters relevant to various spatial scales and administrative levels. Its application might lead to more efficient ways of carrying out policies for prevention of and coping with extreme events. However, in the case of micro-scale parameters data availability is questionable and detailed study might be necessary.
- It is practical and goal-oriented; it can provide with VU scores directly and rapidly.
- It includes all phases and versions of VU in the time scale. The matrices concern a wide range of parameters integrating the response-preparedness-prevention-remediation chain.

Disadvantages of the methodology (out of its application to Ilia and the forest fire hazard)

- Forest fire matrices reflecting the four periods of VU are separate and independent from each other. The same is valid for the four carrying systems. This means that, the matrices framework is lacking the interrelations between VU phases and facets.
- Application of the methodology seems to be more effective and feasible in developed rather than developing countries. Only developed countries keep good quality information bases.

Disadvantages of the methodology (out of its application to Ilia and the forest fire hazard)

- For some parameters the ratings of the VU scores rely (to a large degree) on subjective judgements. This creates risks as opinions may differ regarding the effect of each parameter on VU, especially in the scale 2-4.
- In several parameter cases the impact on vulnerability is unknown even by the experts or responsible authorities. It depends on parameter combinations as well as on place and hazard particularities.
- The methodology is lacking consideration of the relative weight and hierarchy of parameters regarding their impact on VU.
- The methodology is lacking the algorithm for producing a general VU score for each matrix and the whole series of matrices too that can represent the VU state of an area.

Disadvantages of the methodology (out of its application to Ilia and the forest fire hazard)

- The methodology does not give any hint about the scale of the area (or the range of scales) that it is appropriate for. As a result several parameters seem irrelevant to the scale of the area selected.

Ilia case study: lessons learnt

- In certain cases while a critical parameter is in place and can be estimated its impact on vulnerability is unknown, it might be either positive or negative.
- The problem of subjective scoring for some of the parameters was also revealed. A more detailed and precise explanation of criteria and classification of parameter values is a prerequisite for more objective scores.
- The application of the methodology showed that a rating regarding the importance of each parameter is essential in order to arrive at a reasonable final score of vulnerability for each system and each matrix referring to a specific area (or sub-areas).

Conclusively

- First results from the matrices as applied in Ilia Prefecture, Greece, offer a valuable depiction of vulnerability as they give a clear idea of the problem and causes of damage in the area and can be used as a tool for future improvements.
- In any case there is a long way before the perfection of the ENSURE methodology and its widespread adoption by public and private end-users.
- Nevertheless, what we have at hand is already a significant step forward in the field of risk and vulnerability management.

Thank you for your attention