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D3.1 CRITERIA FOR SELECTION OF SAMPLE FOR SURVEYING THE DISADVANTAGED PEOPLE’S HAZARD VULNERABILITY

Project acronym: BuildERS

Project title: Building European Communities’ Resilience and Social Capital

Call: H2020-SU-SEC-2018-2019-2020/H2020-SU-SEC-2018

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Executive Summary

Natural and man-made disasters affect those who have different types of pre-exiting conditions and lack resources and capabilities to protect themselves against dangers. Several of these groups live on the fringes of society, invisible or ignored, discriminated against, and excluded from societies' protective nets and public welfare.

The BuildERS project will to disclose how the unmet social needs and official exclusion that make some individuals severely vulnerable might have affected these persons' capabilities to cope with adversities inflicted by natural and man-made hazards. As this issue has not yet been explored properly it deserves a systematic scientific inquiry carried out by WP3 T3.3 international survey.

To this end D3.1 has reviewed a multitude of hazard impacts and epidemiological studies which confirmed that certain individuals or groups suffer from severe marginalization which make them particularly vulnerable to health and life threats imposed not only by the abrupt onset - disasters but also by long-term atmospheric variability derived from climate change, which do not cause immediate material damage.

Records of natural hazard impacts affecting European populations were retrieved from several disaster data bases, emergency service records, social media postings and newspaper chronicles. The most often occurring were wildfires, floods, earthquakes, storms, heatwaves, physical attacks and explosions. Disasters severity has aggravated recently due to climate change. Wildfires, are more common and last longer in Southern Europe, and they wreak high death toll. Fire-blaze damages also inflict large-scale human and material destruction and loss of economic livelihood for many EU citizens.

The largest effect of heat waves has been observed among the elderly (75+), but also among younger adults. People with disabilities are more prone to psychological stress and physical ailments induced by extreme ambient conditions. Manual labourers, migrants and refugees may lack access to shelters with cooling or heating facilities and thus suffer from abrupt natural perils and temperature shifts.

Several studies confirm that homeless people are particularly vulnerable to meteorological variability, such as long spells of hot or cold weather, and slow-motion atmospheric changes in temperature extremes because the risk for mortality and morbidity arising from these factors correlates closely with characteristics of homeless individuals. Homeless are often forced to live in hazard-prone areas, lack appropriate resources to protect themselves against potentially harmful events and are often denied emergency shelters even in a case of hazard.

Using traditional social survey sampling techniques for recruiting vulnerable informants to assess how they were affected by different types of disaster and which factors promote or reduce resilience, is clearly inappropriate. That's why the Salvation Army stepped in to provide access to large populations of severely disadvantages individuals who receive humanitarian aid at the agency's service stations across Europe. A common impact of natural and man-made hazards on people suffering from several hardships and marginalization is that they require external aid from professional providers and humanitarian organisations. To access the groups that usually are excluded from public support, the

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BuildERS researchers got passage to the Salvation Army clients who receive support in the EU 26 countries.

Different disasters affect different populations and social groups differently, and their impacts are specific with respect to geospatial pattern of areas hit, the level of pre-existing physical and social resilience, and the risk of hazard exposure.

Deliverable 3.1 links the results from multiple empirical studies of human and societal vulnerability with the maps visualizing the hazard discharge areas and the settlements affected. The maps were retrieved from Copernicus emergency service and other disaster databases to visualise the scale of geographical areas affected, the level of physical damage and propagation trajectory.

In summary, the rationale for identification of vulnerable populations from which the survey samples will be extracted relied on three criteria, 1) Persons suffering from social exclusion and marginalization, such as the collectives of Salvation Army's service recipients, 2) Satellite maps evidencing spatiotemporal proximity of hazard events during 2015-2019 to the Salvation Army's social service provision stations and the catastrophic damage propagation in the form of human, physical, and material losses, and 3) Excessive mortality among severely vulnerable groups in different countries attributed to slow-motion deadly atmospheric variability. Based on this empirical evidence, the following social groups have been designated as socially, economically and medically vulnerable and that's why should be interviewed by the BuildERS international survey

1) Elderly individuals 65+ who might have been exposed to weather extremes
2) Homeless individuals, homeless families with young children, single children and young adults, exposed to hazard injuries. Homeless people in regions affected by fires who might have suffered from the loss of possessions or injury due to inability to access shelter and/or safety spot created by fire fighters
3) Homeless people with disabilities and physical and mental impairments
4) Homeless refugees and registered /unregistered migrants in large urban centres whose health conditions make them susceptible to excess mortality caused by atmospheric variability and other events linked to climate changes such as pluvial and fluvial floods and fire disasters, but also hazard imposed physical and material destruction.

The above designation provided a framework for high-precision sample incorporating numerous cohorts of vulnerable subpopulations in the EU that could not be reached by traditional random digit dialling telephone numbers or household surveys. Using access to the Salvation Army's welfare service systems, and/or other humanitarian support amenities, this procedure will allow to gather data from a multitude of informant strata, whose life situations and vulnerability differ broadly within and between the different countries.

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List of Acronyms

AB	Advisory Board
BuildERS	Building European Communities Resilience and Social Capital project
CI	Confidence Interval
D	Deliverable
DoA	Description of Action
FG and FGI	Fragmentation Geometry and Fragmentation Geometry Index (FGI)
GDP	Gross Domestic Product
HI	Heat Index
LGBTI	Lesbian, gay, bisexual, transgender and intersex people
MMT	Minimum Mortality Temperature
NGO	Non-governmental Organisation
RR	Relative Risk
T3.2	Task 3.2 in WP3
UTC	Universal Thermal Climate Index
WP	Work Package

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1. INTRODUCTION AND PURPOSE STATEMENT

WP3 of the BuildERS project shall assess how persons in precarious life conditions have coped with natural and man-made hazards that hit Europe during 2015-2019, and what impacts these events might have exerted on their life quality, social wellbeing, health, and economic welfare.

The BuildERS DOW WP3 states that to assess how the different forms and levels of human and social vulnerability imposed by physical, social, economic, cultural, institutional, political exclusions at pre-hazard stage might have disproportionally inflicted more harms on some social groups than on others at post-hazard time, will be explored through empirical studies of how these individuals coped with natural and man-made emergencies. To this end, an international survey of vulnerable populations' hazard exposure will be performed in WP3 T3.3, testing empirical validity of the theoretical framework elaborated by WP1 and WP2.

In this context, D3.1 will identify the hazard events and locations of vulnerable populations who might have been affected by hazard impacts and thus need to be recruited to two research studies. The first, a small one, composed of 10-20 interviews performed by T3.2 will be used for piloting, testing out and validating the utility of data collection instrument before a full-fledge survey commence. The second and larger sample will be derived by T3.3 from a multitude of vulnerable groups to gather data on how these informants coped with past hazard disasters in 14 country locations.

The DOW provides rationale for selecting the recipients of the Salvation Army's humanitarian aid as candidate population from which research samples will be extracted. As several of these vulnerable collectives live at the fringes of society and could be hard-to-access for scientific inquiry, the WP3 stated that BuildERS partner, the Salvation Army will facilitate access to its clients so that the researchers could " expose the real-needs for protection, resilience, social justice and lack of welfare these people endured at the pre-event time and collect their testimony re-counting what immediate and long-term consequences these hazard crises have inflicted on their welfare" (DOW p.39) .

Thus, the D3.1team turned to D1.2 and D2.1 for conceptual definitions of societal and institutional inequalities that rendered the Salvation Army' service recipients severely vulnerable. It combined the records of natural and man-made hazards that hit Europe during 2015-2019, and the scale of human, material and economic losses imposed with insights from medical analyses of links between atmospheric disasters (floods, cold and heat waves, and the long-term ambient variability) which collectively contribute to excess mortality, particularly among the highly susceptible persons. As a result, WP3 D3.5 will create new knowledge informing social policy makers how to design and implement more inclusive civil protection strategies which incorporate the vulnerable people's needs for legal, social, economic, political and personal inclusion.

To this end, D3.1 pursues four specific aims:

1) Identify the natural and man-made hazards recorded during 2015-2019, their discharge areas and human, material and economic losses in proximity of the Salvation Army's humanitarian service provision stations whose clients will constitute target population from which the sample of informants for survey study will be drawn

2) Review the latest studies on socio-economic and medical characteristics of the most vulnerable groups whose representatives are potential informants to BuildERS T3.3 survey. Explore the consequences that these disasters have imposed on affected individuals' life

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quality and identify the medical and social vectors that increase the risk of death caused by the atmospheric perils which by themselves do not impose the immediate physical damage.

3) Create knowledge base for selection of hazard-stricken countries where the Salvation Army's service stations are located.

4) Identify the socio-economic and demographic features of the populations in hazard discharge sites /regions to identify the sub-populations from which the informant samples for the T3.2 and T3.3 studies will be recruited.

To attain these objectives, the BuildERS project team had to access the disadvantaged populations to recruit survey informants. However, as many of these individuals live at the fringes of society, they are not easily approachable. There is no official statistics cataloguing the different categories of vulnerable groups, their whereabouts and counts. Further, because of transient life pattern, suffering from addiction, a lack of permanent domicile and job, legality of stay, and involvement in semi-legal activities, these persons might avoid contacts with administrative and law enforcement authorities. For these reasons, the Salvations Army stepped in to facilitate the access to large population of relatively disadvantaged persons who are recipients of the agency's humanitarian aid and other community services provided in the EU, from which the survey samples could be derived.

The Salvation Army is a non-governmental humanitarian relief agency with presence in 130 countries (2020) and with 156-year-experience in assisting people in life crises. The agency is usually among the first to arrive with help after natural or man-made disasters (Wikipedia, 2021). The Salvation Army officers and functionaries are well trained to alleviate suffering and bring mental and physical relief to people in perils. These skills have been forged during fighting the world' worst disasters such as the Indian Ocean Tsunami, hurricanes Katrina, Rita, Andrew, Hugo as well as more recent crisis created by the EU inflow of refugees and migrants during 2014-2015.

The Salvation Army assumed the ethical and humanitarian responsibility for providing support to large inflow of refugees from Syria and other war-stricken countries in 2015-2016 for which it gained appreciation from the European Commission ECHO Directorate and authorities in the refugee destination countries (Greece, Italy, and France). By providing special aid programs and facilities, the Salvation Army offers protection, support, and education to marginalized, disadvantaged and/or discriminated groups of people who often live at the fringes of society and are excluded from institutionally supplied social and welfare services (Atlas of European Migration, 2019). Salvation Army offers practical support for families with children, seniors, single women (often threatened by human trafficking). Shelters, food, warmth, and safety to the homeless, and minorities (LGBTI and Roma people) are also among the aid supplied as are the rehabilitation from drug and/or alcohol addiction, help to disaster survivors, and vocational-job-training for young individuals. Emergency lodgings for those who lost housing, and financial support for unemployed and/or those lacking work permits are also among the humanitarian schemes. Salvation Army also provides temporary housing and basic safety and support to irregular migrants and refugees with/ without residential permits, and those who either crossed the EU borders illegally or are the non-EU residents whose asylum /residence applications were rejected and have been ordered to leave the EU immediately (see next page). The figure below presents in schematic format different empirical manifestations of social exclusion which also reduce the scope of social capital the recipients of the Salvation Army's services suffer from.

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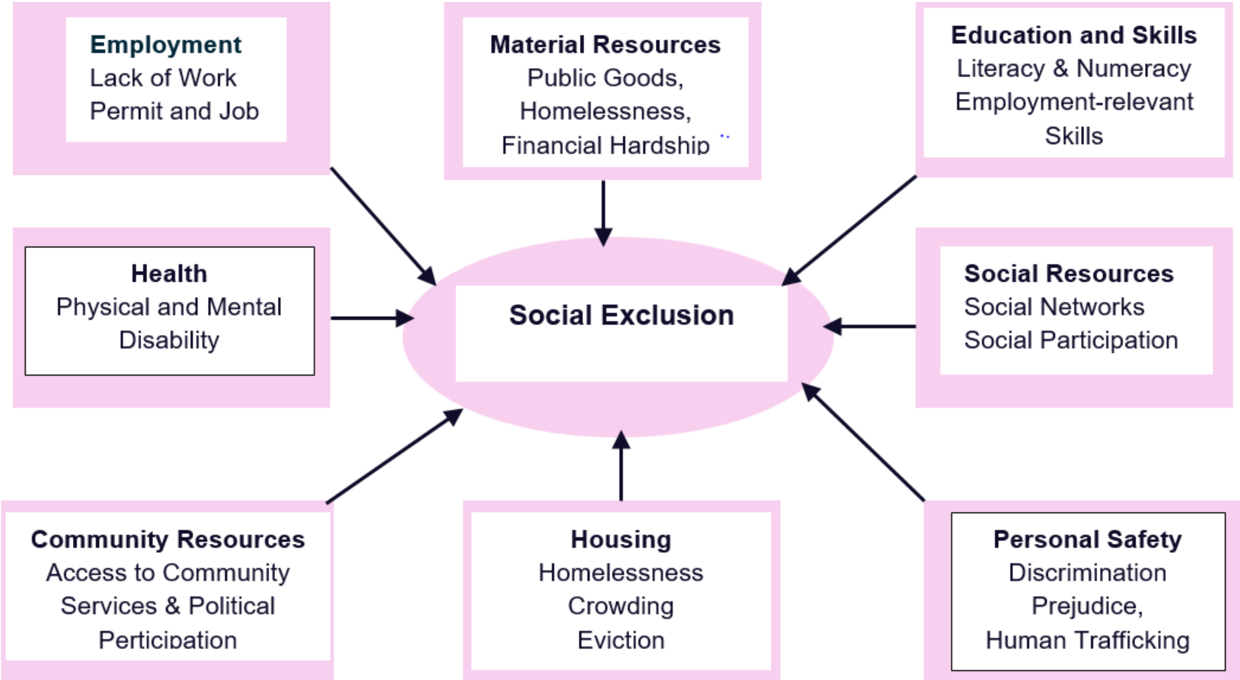

Figure 1: Empirical Manifestations of Social Exclusions and Deficiency in Social Capital.
Source: Labonte et.al., 2011

The agency also ensures that clients in need of medical treatment who do not have access to the host countries' health care systems, could be treated by medical professionals at the Salvation Army's service premises.

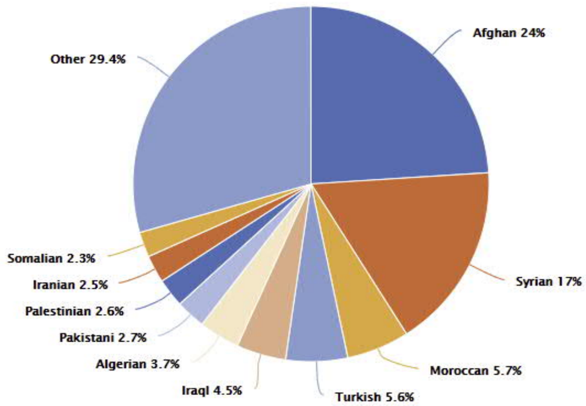

Figure 2: Illegal Border Crossings by Nationality, 2019.
Source:
ec.europa.eu/info/strategy/priorities-2019-2024/promoting-our-european-way-life/statistics-migration-europe_en#illegalbordercrossings

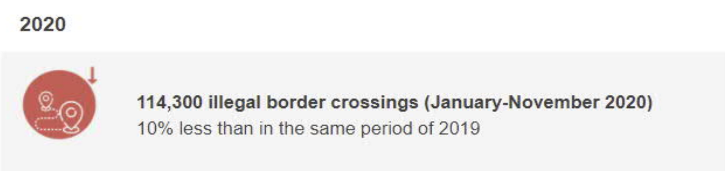

Figure 3: Number of Illegal Border Crossings (January-November 2020).
Source:
ec.europa.eu/info/strategy/priorities-2019-2024/promoting-our-european-way-life/statistics-migration-europe_en#illegalbordercrossings

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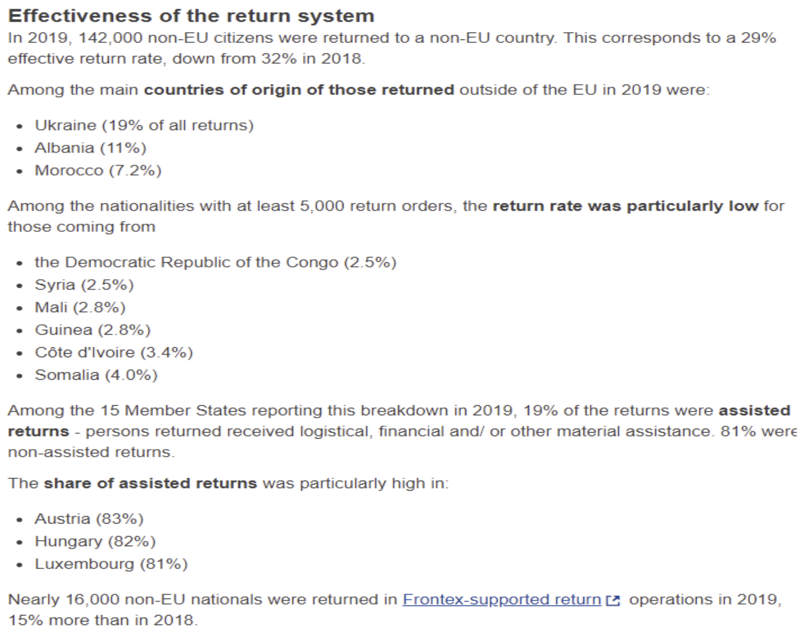
Table 1: Effectiveness of the EU Return System for Asylum Seekers



Effectiveness of the return system

In 2019, 142,000 non-EU citizens were returned to a non-EU country. This corresponds to a 29% effective return rate, down from 32% in 2018.

Among the main **countries of origin of those returned** outside of the EU in 2019 were:

- Ukraine (19% of all returns)
- Albania (11%)
- Morocco (7.2%)

Among the nationalities with at least 5,000 return orders, the **return rate was particularly low** for those coming from

- the Democratic Republic of the Congo (2.5%)
- Syria (2.5%)
- Mali (2.8%)
- Guinea (2.8%)
- Côte d'Ivoire (3.4%)
- Somalia (4.0%)

Among the 15 Member States reporting this breakdown in 2019, 19% of the returns were **assisted returns** - persons returned received logistical, financial and/ or other material assistance. 81% were non-assisted returns.

The **share of assisted returns** was particularly high in:

- Austria (83%)
- Hungary (82%)
- Luxembourg (81%)

Nearly 16,000 non-EU nationals were returned in Frontex-supported return operations in 2019, 15% more than in 2018.

Source: https://ec.europa.eu/info/strategy/priorities-2019-2024/promoting-our-european-way-life/statistics-migration-europe_en#RefugeesinEurope

The multiple vulnerabilities the Salvation Army's clients suffer from could be related to illegal migrant status, economic poverty, stigmatization, past conviction, social isolation and cultural prejudice against some ethnic groups or foreigners, but also to institutional discrimination and negative biases deeply rooted in some of the EU host countries' institutions. Given the social exclusion that these individuals endure, which makes them dependent on the Salvation Army for food, safety, and basic survival items, it is quite understandable that these people do not seek visibility, self-identification, or exposure to administrative scrutiny. Thus, accessing these hard-to-reach subpopulations would be impossible without the help from humanitarian service providers and safety guarantors such as the Salvation Army's aid professionals.

The traditional methods of obtaining probability sample from "invisible" populations such as random digit dialing telephone numbers or household surveys are infeasible. In addition, given the stigma attached to many of the Salvation Army's clients, the prospective informants might refuse to provide personal information/data without safety and security guarantee provided by Salvation Army care personnel (Hecathorn, 1997). Thus, the access provided by the Salvation Army's officers and the staff will produce a framework for high-precision population stratification into multiple and different samples.

Since the Salvation Army's aid recipients exceed 2.5 million people yearly, better understanding of what is the scale of values lost in terms of quality of human life, healthy life span, social contributions and economic opportunities because of the protracted exclusion, will produce empirically validated knowledge underlying the urgent, large-scale efforts and actions that political and institutional leaders, educators and scientists can undertake to redress the pervading inequalities and the long-standing discriminatory practice.

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In this context, obtaining inobtrusive passage to large collectives of severely vulnerable populations comprising a multitude of groups and cohorts which suffer from protracted marginalization is an added value that the BuildERS project will turn into new knowledge that no prior research undertaking had delivered before.[1] The access to a broad aggregate of people living at the fringes of mainstream societies in the different socio-political contexts is itself a methodological *innovation* not demonstrated before.

Deliverable 3.1 is composed of six chapters:

Chapter 1 presents background and the D3.1 study objective.

Chapter 2 presents ArcGIS integrated maps of large-scale natural and man-made hazards during 2015-2019 and beyond, and time-spaced mapping of hazards geospatial coverage to pinpoint the affected BuildERS-study countries and the Salvation Army's service provision stations for piloting the survey instruments in Estonia, Belgium and Norway.

Chapter 3 reviews the most severe geophysical, hydrological, meteorological and climatological hazards, which over the recent decades inflicted human fatalities and severe material and economic losses. The review stratifies people affected by death tolls, geospatial locations and values of material destruction. Subsequently the data and statistics documenting the latest occurrences of fire and flood disasters, damage scope and populations gravely affected, are presented.

Chapter 4 raises our awareness toward the fact that in addition to rapid-onset catastrophic events which inflict major toll on human lives, especially among vulnerable people, some other slow-motion-ambient changes also endanger human life. It reviews the medical research that documents how climatic variability which over the last 20 years caused changes in ambient conditions across Europe also poses severe threats to human life and wellbeing although it does not invoke any visible material damages. Consequently, the epidemiological studies reviewed identify several categories of the most vulnerable populations whose health and lives have been grievously imperilled by climate change, and who qualify to be interviewed by international survey.

Chapter 5 presents how selection of severely vulnerable groups to survey study will be organized and what ethical and practical considerations will be guiding this process.

Chapter 6 presents a summary and conclusions.

All six chapters complement and support each other for broadening the D3.1 empirical validity.

The following terms are used in D 3.1:

Hazard (BuildERS definition from D1.2 Appendix A): A process, a natural phenomenon or human activity that may cause loss of life, injury or other health damage, physical damage, social and economic disruption or environmental degradation.

Resilience (BuildERS definition from D1.2 Appendix A): Processes of proactive and/or reactive patterned adjustment and adaptation and change enacted in everyday life, but, particularly, in the face

[1] According to Salvation Army's utterance, no systematic scientific inquiry into how the precarious life conditions of its clients might affect their capabilities to cope with adversities inflicted by natural and/or man-made-hazards has been performed prior to the BuilDERS project.

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of risks, crises and disasters. This definition pertains to personal skills and abilities that might allow a given individual to cope with, bounce back and even grow in the face of adverse life experiences such as strain imposed by natural hazards.

Disaster (BuildERS definition from D1.2 Appendix A): A serious disruption of the functioning order of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and preventive capacity, leading to one or more of the following: human, material, economic and environmental losses and other harmful impacts" (UN-UNISDR, 2019a).

Fragility: Fragility refers to poor health conditions of some individuals or social groups such as pulmonary, cardiac and/or addiction-related ailments that might increase their risk of mortality and/or severe morbidity precipitating early death as consequence of natural and/or anthropogenic hazards (Shell et al., 2020)

Severely vulnerable groups / disadvantaged people: Encompass several subpopulations, who live outside society, and who are lacking a voice and power to make their living situation and the hardships to be addressed by private and governmental decision makers. This links to the understanding of vulnerability in BuildERS as dynamic qualities of all individuals (see D1.2 and D2.1). Also, individuals who are considered here, suffer from social exclusion and poor life conditions even before a hazard strike. Therefore, they are exposed to much higher health and life- threatening risks inflicted by hazardous event. These groups of diverge on gender, age, disabilities and health conditions, but also come from different social and ethnic backgrounds, educational and experience levels and national contexts. They include socioeconomically and/or medically disadvantaged people (compared to general populations), groups and/or community assemblages, which due to the systemic inequalities suffer from uneven distribution of resources and wealth, oftentimes underpinned by structural racism and/or class divisions. (Shell et al., 2020).

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2. METHODS USED AND DATA SOURCES

To give the voice to the most vulnerable groups, WP3 will focus on recipients of social services of humanitarian aid organisation, the Salvation Army. Studying Salvation Army's capacities to deal with disasters might produce an important and novel insight into the interplay between the pre-event vulnerability conditions, and the negative hazard impacts.

In so doing, the D3.1 will assess and present the various empirical manifestations of multifaceted theoretical concepts such as social vulnerability, deficiency of human and social capital and many others outlined in D1.2 and D2.1. The study started with the records of large-scale natural and man-made hazards. Subsequently, research exploring the social impacts of atmospheric variability which although seemingly innocuous inflicts excessive mortality rates on particularly susceptible individuals were reviewed. Based on the collected information and considering that humanitarian services offered by the Salvation Army aid apparatus provides yearly help to 2.5 million destitute people in the EU countries, the locations where Salvation Army service provision apparatus are available will be selected for T3.2 and T3.3 studies. To facilitate this objective, the study has assessed how the man-made or natural hazards had struck the selected EU countries during 2015-2019 and the settlements in proximity of the Salvations Army's humanitarian aid provision facilities where different groups of destitute persons have been sheltered.

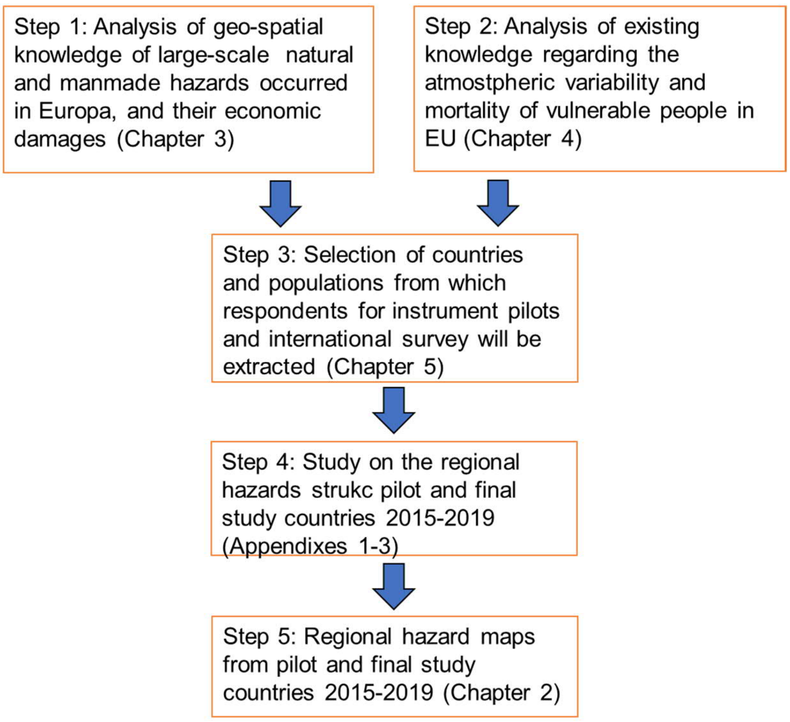

Figure 4: The main subtasks of Task 3.1 in the BuildERS project

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Step 1 overviews the studies on climate hazards that hit Europe over the last 20 years and their impacts on economic, environmental and human welfare.[2]

Step 2 explores different perspectives on human vulnerability which might provide input to formulation of the survey variables, designing the data collection instrument, and linking the geospatial hazard discharge sites with on-the-ground locations of respondent populations.
Step 3 explains how the study countries were selected based on ethical, practical and scientific knowledge which were mandatory in this research.

Step 4 indicates how the data on severe hazard cases were collected from public reports and statistics, media stories and web pages and a list of hazard cases compiled by the partners (Appendix 1-3). Large scale hazard events that occurred between 2015-2019 replaced the period of 2013-2018 stated in the BuildERS DoA. This was done to better match the hazard outbreaks with interview timeline 2019-2021 and reduce the risk to data trustworthiness caused by informants' fading memories.

Step 5 combines the data on hazards' impact areas in the ArcGIS map environment and overlay the regional hazard maps on population density maps and the city boundaries where the Salvation Army social service apparatus is located (Chapter 2). This was done to provide support to the Salvation Army by giving a general view on how different kinds of natural hazards hit and impacts were discharged across Europe.

2.1 Mapping the Hazards Cases

This chapter presents several maps retrieved from satellite images of hazard outbreak sites whose content will be used as a background knowledge for assigning the locations where the severe vulnerable populations might be settled and for drawing the samples of candidate respondents for the WP3.3 international survey. The discharge areas of the hazards are presented for the geospatial delimitation of territories. The background map includes the information of areas economic wealth derived from statistics on the Gross Domestic Product (GDP) per capita.

2.1.1 Criteria

Criteria for selection of countries and areas delineating the survey perimeters are based on the research presented in D1.1 and D2.1. Accordingly, the geophysical hazards imposing high death tolls among general population will be reviewed in Italy and Greece. In northern and central Europe, the relatively high numbers of homeless people who might suffer from premature deaths could not be directly linked to severe catastrophic events but rather to climate-change-induced heat waves atmospheric variability, and frequent flooding.

Against this backdrop, the following hazard selection criteria are proposed:

- Hazards that caused human deaths, injuries and/or large-scale displacement,
- Hazards that affected large number of people (N in 1 000's),

[2] The time frame was extended to evidence the lingering time-deferred damage imposed by some hazards whose secondary and tertiary destruction has badly affected the human and economic welfare over many years after the actual event stroke.

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- Hazard that inflicted extensive immediate damages to buildings, roads, telecommunication, health- care providing facilities or water supply,
- Heat waves and other meteo-anomalies
- Hydrological disasters like pluvial and fluvial floods and the related ground movements and the structural damages imposed on infrastructures and/or building foundations,

Hazard registered by Copernicus emergency service that instigated national governments' requests for international help, either for monitoring or mapping the discharge areas and for assessing the geospatial magnitude of social, economic and physical damages to call help for humanitarian evacuation, emergency and relief logistics bringing necessary rubble/debris moving equipment, medicines, and other emergency-reducing materials.

2.1.2 Information Sources on Hazard Events

The hazard cases have been inventoried by inspection of first responder's reports, media stories and web pages associated with natural and man-made disasters. Important sources of data included:

1. Reports like the Annual Disaster Statistical Review 2016 - The numbers and trends.
2. Copernicus emergency service https://emergency.copernicus.eu/mapping/list-of-activations-rapid. These pages provide information on hazards globally since 2012, the year when the European Space Agency's Sentinel series satellites have been operating. It registers hazards for which a satellite imaging request has been provided to the national official authorities, to help in monitoring the impact areas and hazard damages. Appendix 1. shows the locations of these hazards for years 2015-2019. The hazard types and damages best represented by satellite image monitoring are wildfires and floods, large areas of fallen trees due to storms, whose extents can be accurately mapped from optical satellite images like Sentinel-2. Earthquakes and landslides ordered by the imaging requests are monitored with radar imagery like Sentinel-1. In optimal cases, the pages provide detailed maps and statistics on damaged buildings, see Appendix 2. These pages are active and show very recent global hazards occurred in a time space of the last few days.
3. European severe weather database (https://www.eswd.eu/, https://www.essl.org/cms/european-severe-weather-database)
4. Estonian Weather Service, https://www.ilmateenistus.ee/?lang=en
5. Emergency database CRED (https://www.emdat.be)
6. BuildERS partners and national authorities in their countries provided detailed information on hazards from national databases, emergency management services and newspaper chronicles.
7. Swedish forest service https://www.skogssverige.se/skog/stormfallning/kanda-stormar
8. Finnish Meteorological Institute https://ilmatieteenlaitos.fi/tiedote
9. NASA earth observatory https://earthobservatory.nasa.gov/images/
10. USGS earthquake events https://earthquake.usgs.gov, https://www.usgs.gov/natural-hazards/earthquake-hazards/lists-maps-and-statistics, https://earthquake.usgs.gov/earthquakes/search/

2.1.3 Records of Hazard Events and Categories

For cataloguing the hazards reviewed, the following criteria were used:

1. Type of hazard
2. Country affected

3. Date of start
4. Date of end (if known)
5. Link to Copernicus emergency system depicting hazard discharge area or the name of the city/cities or region/s within the discharge area, from the source in field 11 or 12.
6. Free text for description of hazard, regions, areas affected, name of the hazard
7. Mortality (if known)
8. Number of injured individuals (if known)
9. Number of other individuals affected immediately by the hazards
10. Extent of immediate damages, like number of hectares of burned forest, or number of households without electricity (if known)
11. Primary source of information
12. Additional source of information
13. Copernicus emergency service ID

Appendix 3 shows the table with selected hazards and their attributes. It contains 119 hazards that have occurred in BuildERS-study countries between 2015 and 2019.

2.1.4 Integrated Maps of Hazard Cases

The next subchapters review the hazards whose impacts on vulnerable people's health, wellbeing safety and accommodation will be probed by the instrument pilot and the survey study. The hazards and their impact areas were collected from the ArcGIS map environment. The figures contain the same selection attributes as presented in subchapter 6.1. The country specific figures show extracts from the integrated maps with hazards impact areas and the Salvation Army's operations cities (in green) and the levels of gross domestic product per inhabitant. The Gross Domestic Product (GDP) layers indicate which socio-economic strata of people have been affected by hazard impacts.

All these figures are taken from the ArcGIS Online Dataset. The GDP layer are retrieved from the ArcGIS online datasets, the GDP unit is €/year, and presented at NUTS 3 level.

2.1.4.1 Austria

During 2015-2019 Austria was hit by floods and storms (Figure 5). In 2018 in October, an intense weather event with heavy rain and very strong wind occurred in the South of Austria. The storm called "Vaia" has hit the regions of Carinthia and East Tyrol. In January 2019, heavy snowfalls and avalanches caused severe forest damages partly in the same area, partly in the western region of Austria. In November 2019, a destructive flood hit the same area. Numerous landslides and debris flows in the mid-Alpine regions of Salzburg, Upper Styria and Carinthia have followed inundating the same catchment areas.

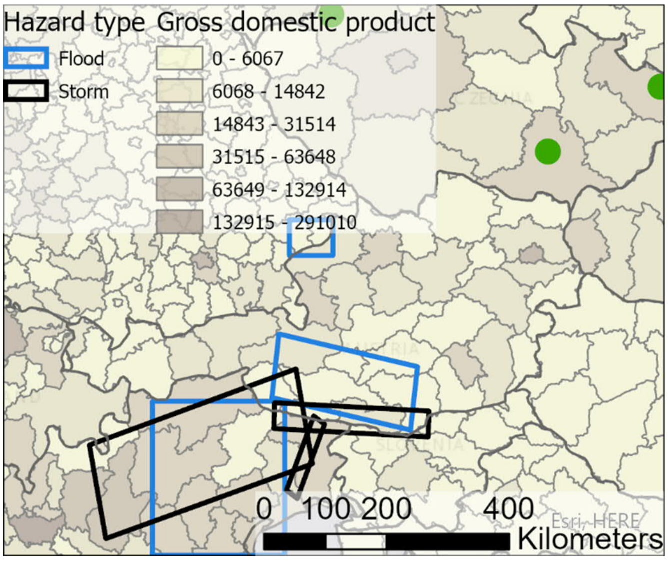

Figure 5: Hazards in Austria 2015-2019

These three climate hazards hit mostly the southern part of Austria, which belongs to eastern part of the Alps. The GDP in the counties affected

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by these calamities are under €14 842 which is quite low. The premises of the Salvation Army are in Vienna which is not within the destruction areas. Thus, it is unlikely that the respondents to the survey have been affected by these disasters, unless they have fled the harms imposed by these adversities to find shelter in Vienna. This issue will be clarified with the Salvation Army's help station personnel.

2.1.4.2 Belgium

The map of Belgium (Figure 6) presents the hazards whose impact areas covers the city of Brussels. Heat extremes, heat waves and storms are the events that affected Brussels inhabitants, particularly homeless groups, elderly or disabled living in lightly built households or without efficient air conditioning, as well as people who worked outdoors.

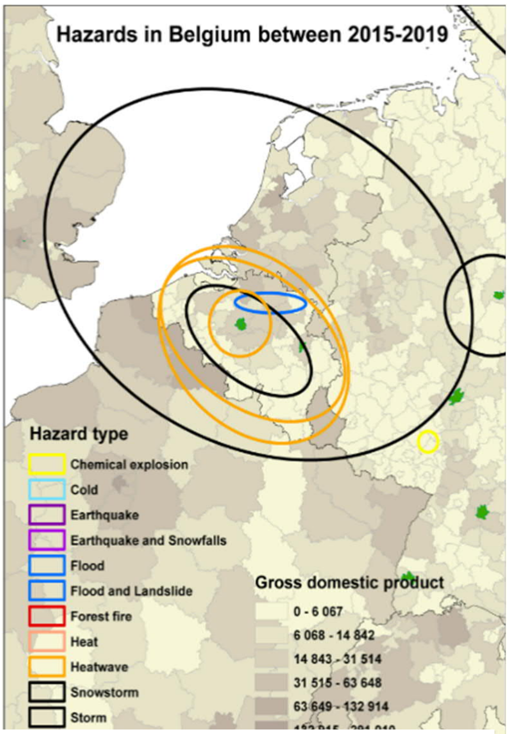

Figure 6: Hazards in Belgium between 2015 and 2019 with SAL Cities in Green

In June 2016 four days of heavy rain caused flooding in several areas of Belgium. At first, widespread flooding hit northern Antwerp and the west of Flanders and after that waters kept rising in the eastern areas around Limburg and Liege. Several neighbourhoods were evacuated as cellars have been flooded and streets were submerged by overflowing creeks and rivers. One major train line linking eastern Limburg with the capital had to be suspended. No deaths were recorded but big economic and asset damages.

The GDP in the north-west side of Brussels is quite high; in Antwerp area it is € 63 649-132 914 and in the other areas €31 515–63 648. The GDP in the area south form Brussels is lower than in the northern area. The two premises of the Salvation Army are in Brussels and Liege. The area of Brussels was hit by heat wave during the study period, and the area of Liege was exposed to both heat waves and floods. These disasters might have affected the wellbeing and life conditions of the candidates for survey respondent.

2.1.4.3 The Czech Republic and Slovakia

In the Czech Republic and Slovakia no natural hazards were reported through the Copernicus Emergency Service except for the storm that hit on the border with Germany in October 2017 (Figure 7). Then the heavy storm affected several areas in Erzgebirge with damages mostly in the forest areas, with many fallen trees. This might have had also impacts on the neighboring areas in the Czech Republic.

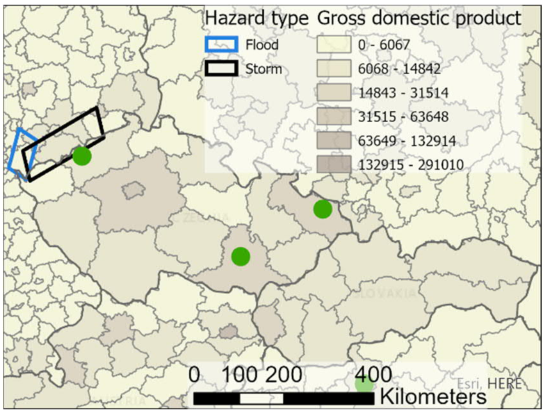

Figure 7: Hazards in Czech Republic and Slovakia between 2015 and 2019 with SAL Cities in Green

Otherwise, no hazards were recorded by satellite images in the target area during 2015-2019. However, heat waves and cold periods may have affected also these areas.

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The Salvation Army shelters are in the west of Karlovy Vary in eastern Ostrava and in the Brno centre, so the clients stationed there might have been exposed to these perils and recruited to the survey study.

Inhabitants in area of Karlovy Vary might have suffered from a severe storm in 2017. The population settled in the hazard discharge areas also suffers from the second lowest GDP level per capita in the country. The other two areas with SAL's shelters have higher GDPs.

2.1.4.4 Estonia and Lithuania

Estonian and Lithuanian areas have not been suffered from huge natural disasters (Figure 8). Only adverse weather condition has been reported in the Silute municipality, in Lithuania. The emergency was declared in January 2018 after the first flooded areas around Rusne affected six villages. Rusne locates in the delta of the River Nemunas.

The GDP of the areas varies from € 6 068 to 14 842 and thus, it is the second lowest category of GDPs.

The SAL shelters are in Tallinn, north of Estonia, but also in Lietuwoje and Klaipeda in Lithuania. The city of Klaiped is situated north of Rusne area, and thus it is possible that the respondents of the survey have been involved in the flood hazard in Rusne.

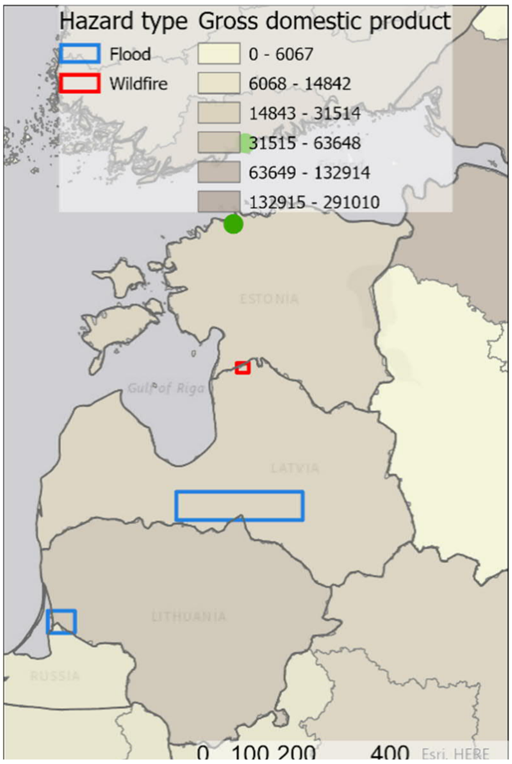

Figure 8: Hazards in Estonia and Lithuania between 2015 and 2019 with SAL Cities in Green

2.1.4.5 Finland, Sweden and Norway

In Finland, only one natural disaster was recorded by the Copernicus Emergency Service registry. It was the flood in the River Tornio, which is the border river between Finland and Sweden. In May 2018, it was an extensive spring flooding due to the quick snow melting which has worsened because of warm temperatures and the intermittent rains. The flooded rivers were about to affect residential areas in Tornio.

In Sweden recorded the worst forest fires for decades in 2018. Already in June, warm and dry spring resulted in very dry vegetation. The first fires ignited in Värmland, southeast of Kristinehamn and in Edsvalla. Later, in July, there was over 50 fires ongoing at the same time, and voluntary firefighters came from Finland to help in the emergency. No one was directly wounded but it has been calculated that the fire aftermath contributed to thousands of premature deaths.

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In Norway, in 2018 May a large spring flood caused by rapid snow melting and high temperatures in the surroundings of Lillehammer and Hamar occurred after a winter with an exceptional amount of snowfalls. Also, in the southern part of Norway in the region on Agder an orange color flood alert was announced. Many landslides events were induced, some with considerable consequences, as well as extensive flooding, erosional-and-flood damages in low-altitude areas.

The Salvation Army shelters, where the survey might take place are in Helsinki, Finland and in Oslo, Norway (Figure 9). It is uncertain whether the respondents in Finland have been affected by these floods because the migration rarely goes from south to north due to lack of work opportunities in this country. However, the respondents form Norway might have been affected by the floods around Hamar, Lillehammer and Oslo areas. Both Helsinki and Oslo areas belong to the fourth or fifth category of GDP attainment, ranging between € 1 515 -132 914. The study was not conducted in Sweden, because of restrictions imposed by national authorities.

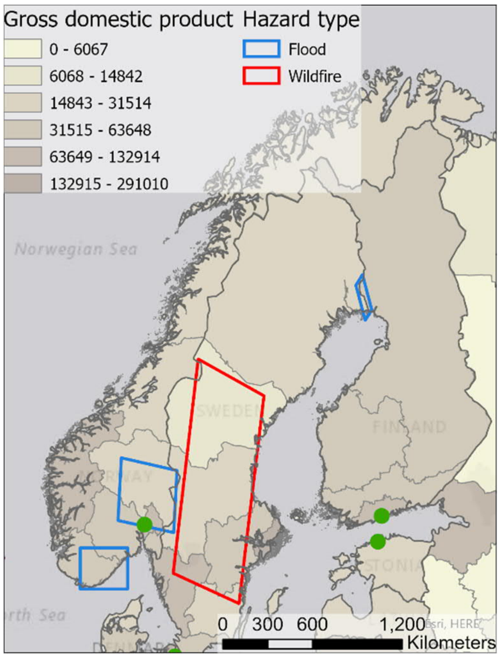

Figure 9: Hazards in Norway, Sweden and Finland between 2015 and 2019 with SAL Cities in Green

2.1.4.6 France

In France the most harmful natural and man-made disasters involved floods and forest fires (Figure 10). Flood in Loiret took place in 2016 in the end of May and the first weeks of June. The departments of Loiret and Seine-et-Marne to the south and at the east of Paris were placed on red alert by the national weather service. Floods affected transportation network, settlements and other assets.

In October in 2016 heavy rain fall (300mm to 400mm) which lasted over 12 hours affected the Herault department. This precipitation was induced by flash flood over Orb, Héraulet and Lèz rivers basins and orange early warnings was announced.

In January 2018 bad weather conditions affected Paris and Northeastern part of France. Other parts of France were also bracing themselves for flooding, with Rhine and other rivers in the east were threatening to overflow.

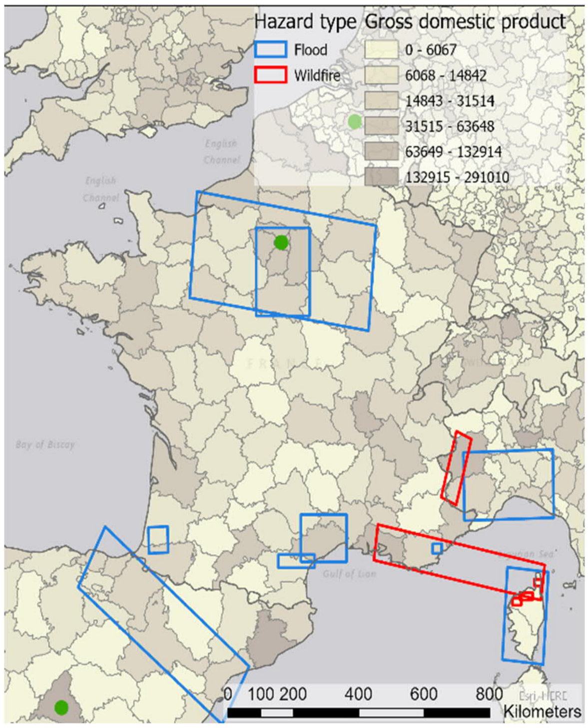

Figure 10: Hazards in France between 2015 and 2019 with SAL Cities in Green

In July 2017, France was facing a severe forest fire situation with three main fires, which were in Corsica (730 ha), in the department of Alpes-Maritimes (70 ha) and in the region of Luberon (635 ha). On July 25the, more than 3000 ha were burned and the blaze lasted three more days.

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The Salvation Army's premises where the survey might be conducted are in Paris. It is possible that the clients have been affected by the flood in this area and/or that some other people relocated to Paris after having their possession inundated. The GDP of people living in the target area is in the range of € 31 515 – 63 648.

2.1.4.7 Germany

Germany has suffered during the study period from forest fires, floods and storms (Figure 11).

In 2018 the forest fires took place in July and August. The first registered fire broken out in July 2018 close to Braesen in Saxony-Anhalt, which burned 60 hectares of grass and forest. In August 2018, a forest fire was ignited in Brandenburg between the towns of Treuenbrietzen and of Jüterborg and spread quickly overnight to engulf 400 hectares. Authorities advised residents of Berlin, Potsdam and neighboring administrative districts to keep windows and doors shut due to smoke. More than 500 residents were evacuated to emergency shelters as the flames threatened to engulf three villages. In September 2018, several fires were ignited in the Lieberoser Heide area, at the north of the city of Cottbus and in southern Brandenburg. The affected regions are located within an old military area and the fires could cause major explosion because of ammunition dumped on the site.

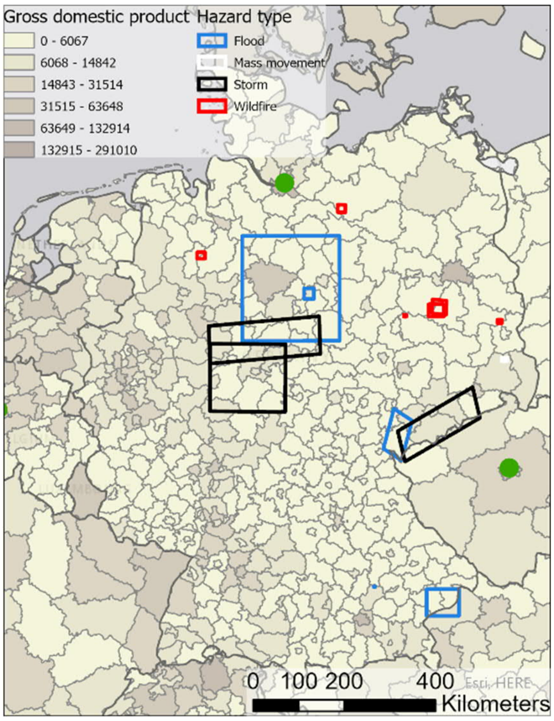

Figure 11: Hazards in Germany between 2015 and 2019 with SAL Cities in Green

In 2019 the first recorded wildfire took place in April in the district of Vechta close to Arkeburg/ Goldenstedt. In June 2019, around 430 hectares of forest were burned in Mecklenburg-Western Pomerania due to a re-ignited forest fire in the municipality of Ludwigslust-Parchim, making it the largest forest fire in the history of the northern German state. The affected area includes a former military training area near Lübtheen that was heavily contaminated with ammunition, which made the extinguishing action difficult. Also, in June 2019, there was a forest fire in the province of Brandenburg in Germany.

The floods were often accompanied by heavy storms. In June 2016 a state of emergency was declared following flash floods and flooding caused by heavy rains in Bavaria, in the southeast of Germany. The most affected areas and towns were Triftern, Simbach am Inn and Tann between the rivers Rott and Inn.

In July 2017 a storm hit nearly every part of the country. It started from the northern and central areas, especially in Braunschweig. The storm brought to Southern Lower Saxony and northern Thuringia 50 - 80 liters of rain per square-meter. In October 2017, a heavy storm affected several areas in Saxony (Erzgebirge) with damages mostly in the forest areas. In November2017, a flooding event hit the Lower Saxony.

The year 2018 started with a storm Friedrike that hit in the middle of January and caused extended damage to forests in the federal state from Northrhine-Westfalia and Lower Saxony and in the West to Brandenburgia and Saxony in the East. In May 2018 a flash floods affected Saxony with damages

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in the Vogtlandkreis area. The last recorded storm took place in September 2018 in the town of Tegernbach, municipally of Rudelzhausen, the federal state of Bavaria. After extensive and heavy rain precipitation the buildings were affected by flash flooding. No loss of life was reported but many streets, structures and establishments were flooded and damaged.

The premises of the Salvation Army are in Hamburg in the north of Germany. It is possible that the survey respondents have been affected by these hazards, because the inner migration in Germany may move people in the other places in search of jobs, or because of damages and/or severity inflicted on them by flooding in previous domiciles. The GDP per capita in 2018 in Hamburg area ranged between, € 31 515 - 63 648.

2.1.4.8 Hungary

In Hungary, only one forest fire (wildfire) was registered during the years 2015-2019 (Figure 12). It took place in 2015 and it damaged and destroyed forest and other natural reserves near Kaskantyú, Hortobágy and Nádudvar. This area is situated to the southeast from the Budapest. The affected forest composed of ancient juniper vegetation (Junipero-Populetum albae) and grasslands (Festucion vaginatae) were of significant value for the preservation of natural reserves.

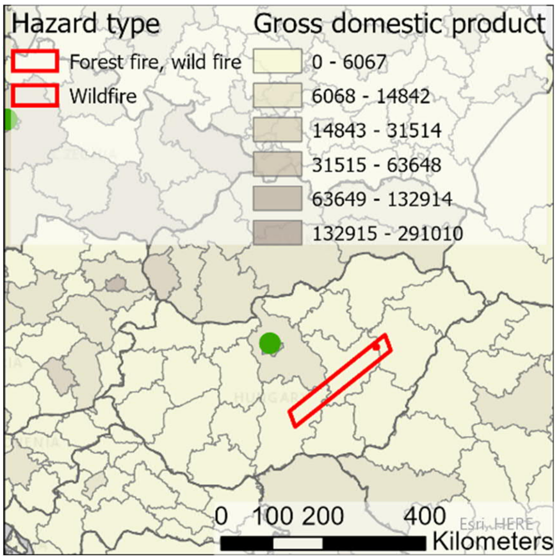

Figure 12: Hazards in Hungary between 2015 and 2019 with SAL Cities in Green

The GDP in the region damaged is among to the lowest in EU, < € 6 067. The Salvation Army' s premises where the survey is to be conducted are in Budapest, which belongs to the second lowest GDP category in the EU, € 6,068 -14 842.

It is unlikely that the respondents of the survey taken in place in Budapest have suffered from forest fire, unless they have lost their possessions and/or other necessities due to fires and became dependent on Salvation Army's service apparatus on food, lodging and clothing. This occurrence needs to be verified with Salvation Army's staff and sampling adjusted accordingly.

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2.1.4.9 Italy

Italy is one of the European countries which has suffered most from the natural hazards during the study period (Figure 13).

The year 2019 was very destructive in Italy, and especially in Sardinia about fire hazards. Already, in July 2019, several wildfires broke out in the northern-eastern part of the Sardinia, near the Siniscola town. The most damaging fire affected a large part of Mediterranean scrub and several agriculture areas. Several houses and farms were evacuated in advance but still the fire destroyed some farms and killed animals.

Later in 2019 still six more wildfires struck the different parts of Sardinia burning at least 1 500 hectares of Mediterranean scrub, pine wood or agriculture land.

In September 2019, a forest fire endangered the municipality of Sarno (Salerno), and the area of the Monte Saretto. The fire spread over to the mountains behind the town of Sarno and for this reason, almost 200 people were evacuated. Over 90% of the Sarno pine forest was blazed by the fire.

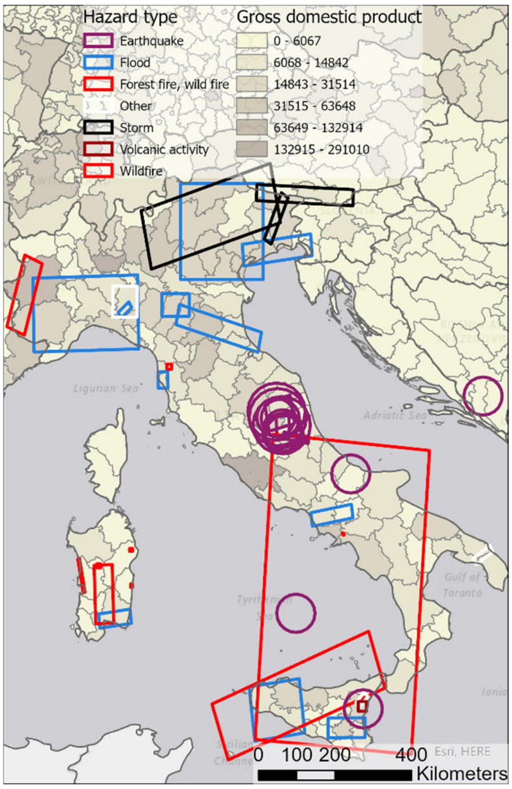

Figure 13: Hazards in Italy between 2015 and 2019 with SAL Cities in Green

At the end of 2018 the Etna volcano in Sicily had a sudden eruption close to its main crater at 3 300 meters altitude. The activity was mainly explosions as well as emissions of lava from several eruptive fissures starting from the base of the New South East Crater. The eruption was followed by an earthquake of magnitude 4.8 degree at Richter scale which hit the same region.

In August 2016 an earthquake occurred in the center of Italy hitting a very large territory including several regions (Lazio, Abruzzo, Umbria) and municipalities. After the main shock several smaller tremors occurred in the areas inflicting casualties and structural damages. In October 2016, a new earthquake, with magnitude 5.4 degree at Richter scale has shocked the central Italy with the epicenter close to the same area suffering from tremors of 5.9 degree in magnitude. After these first shocks, several earthquakes with magnitude higher than 5 occurred in the Central Italy involving four Regions (Lazio, Umbria, Abruzzo and Marche). This earthquake killed 299 people and injured nearly 400. It was as destructive as the earthquake in L'Aquila, the capital of the Abruzzo region in 2009. The earthquake was felt in other parts of central Italy, including the city of Rome, where the metro system and many schools were evacuated. Later, in January 2017 four additional earthquakes occurred in the areas near to those previously affected, particularly, the Abruzzo region. The last event occurred after exceptional heavy snowfalls, and it caused an avalanche in the Gran Sasso mountain in the Abruzzo region killing 29 people.

Floods caused by heavy rains have also hit Italy. Table 2 below shows the regions affected by rains during the study timeline.

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Table 2: Areas Affected by Heavy Rain and Impacts of Weather Hazards

Time	Area	Impacts
September 2015	Liguria Region, Emilia Romagna Region	Severe floods and landslides in the province of Piacenza. Hundreds people were evacuated from the areas alongside of the rivers Nure and Trebbia. At least three persons died in floods.
October 2015	Campania Region Provinces of Benevento and Caserta	The intense rains caused severe floods and landslides on the basin of Calore river in Campania Region. A lot of people were exposed to floods and several damages occurred in particular to the transportation network. Also Volturno river with Capua village and the others villages along the river were exposed.
November 2016	North West of Italy, Piemonte and Liguria	Heavy rainfalls inflicted floods, especially the river Po flooded
September 2017	Tuscany Region, the Municipalities of Livorno and Rosignano	Flooding due to severe rains caused casualties and damages on private houses, infrastructure and assets
October, 2018	Northern Italy. Friuli Venezia Giulia and Veneto regions	The rains affected rapid increasing of the level of Livenza, Piave, Tagliamento and Adige rivers (the highest level of warning). Many people were evacuated in both areas.
October 2018	Southeastern part of Sicily.	The highest intensity of precipitation was recorded in Palagonia (Catania) with 240 mm of rain.
May 2019	Central and northeastern regions of Italy Emilia-Romagna Region	Heavy rainfall with strong winds and hailstorms led to river bank overflows resulting in much damage. Rapidly increasing levels of the Rivers of Savio, Montone, Ronco, Panaro, Secchia, Sillaro and Foglia, caused the highest alert level. The rivers Secchia (Modena), Savio (Cesena), Sillaro (Imola) and Montone (Forlì) rivers burst their banks.
November 2019	Northeaster Italy, Friuli Venezia Giulia and Veneto regions	A deep cyclonic circulation stayed on the Italian peninsula. It caused a high tide in Venice, reaching the maximum value of 187 cm and the marine flooding and storm surge of many areas near the cities of Monfalcone, Grado and Trieste.

Source: Project Compilations

As shown in Figure 13, the areas hit by fires belong to the lowest or second lowest class of GDP categories (< € 18 432). The Abruzzo area belongs to the third category, € 14 843 – 31 514. The floods are common in northern areas of Italy where the GDP is higher than in southern part of the country varying from € 14 843 to 63 648.

The premises of the Salvation Army are situated in Rome. It might have occurred that some of the service recipients have moved to the area of Rome from Abruzzo after destructive earthquakes damaged the region. If this is the case, this cohort may report experience from encountering severely dangerous disaster.

2.1.4.10 Portugal and Spain

Portugal and Spain have been mainly hit by forest fires but in Spain also by floods (Figure 14).

Portugal

During the study period, wildfires have been reported five times in Portugal: Starting in June 2017 an intense heatwave and rainless thunderstorms caused huge forest fires across Portugal, particularly in Leiria District northeast of Lisbon. The fire caused many victims especially among those who were fleeing the blaze while on the road EN-236-1 from Pampilhosa da Serra to Castalheira de Pêra. Numerous towns and villages were evacuated.

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Following in October 2017 at least 27 people have died when wildfires spread across the country amid high temperatures and strong winds fanned by the ex-hurricane storm Ophelia Hundreds. The wildfires forced residents to flee from towns and villages.

In August 2018 wildfire started in the municipality of Monchique, in Faro due to a heatwave which sent the temperature above 45 ºC. This fire burned about 28 000 ha of land. The fire threatened urban area of Monchique and injured 41 people. In July 2019, three separate forest fires broken out in the center of Portugal endangering two villages in the region of Castelo Branco. In Aveiro region several fires ignited in September 2019 damaged several highways.

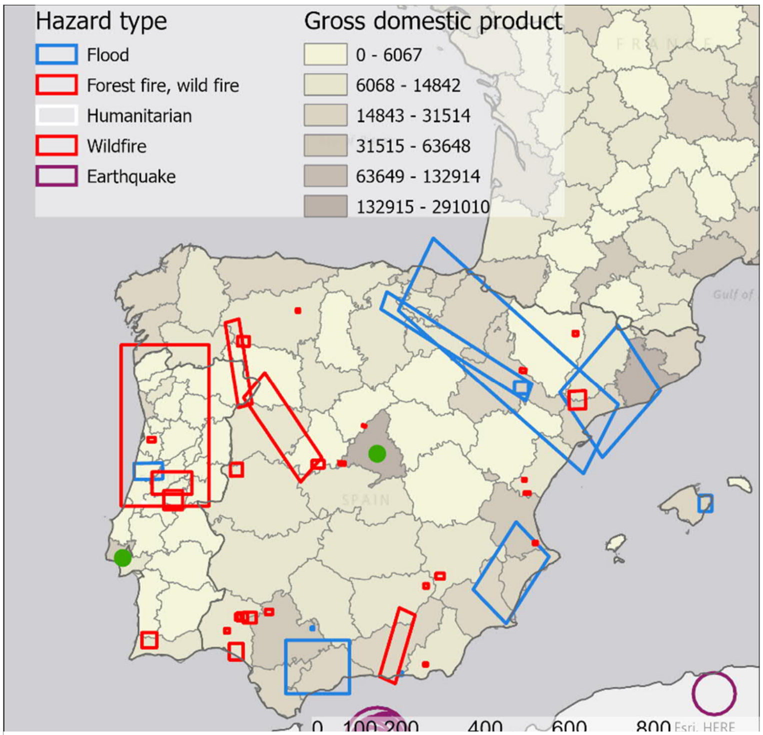

Figure 14: Hazards in Portugal and Spain between 2015 and 2019 with SAL Cities in Green

During the study period one severe storm affected Portugal in December 2019. Then strong winds and heavy rainfall flooded rivers, brought down power lines, uprooted trees and disrupted rail and air travel across the regions. In Coimbra the Mondego River Basin floods and dike breaches occurred.

The affected areas in Portugal belong to the lowest or second lowest category of the GDP classification, < € Portugal 14 843) indicating that the standard of living is a lower compared to many other EU countries. The Salvation Army premises are in Lisbon, which is situated outside the latest emergency areas. However, some of the respondents may have been fled the domiciles because of wildfires which inflicted severe destruction on private and public properties, production assets and infrastructure.

Spain

Wildfires in Spain have incurred at seven different times in the reporting period. In July and August 2015 forest fires blazed the municipality of Acebo, in Cáceres, the villages of Montán and Caudiel in Castellón and the municipality of Quesada in Jaén province and the neighboring municipalities. In August 2017, numerous forest fires affected the central areas of Spain. Again, in 2019 three main fires were reported, in June 2019 about 4 000 ha was burned in the municipality of Cadalso de los Vidrios invoking evacuations of several urban centers. The weather characterized by high temperatures, low humidity and high winds caused the fire extinguishing difficult. In July, in the Sierra de Gádor, province of Almería the fire affected the ZEC Sierra de Gador and Enix and scorched 1 200 ha of land, including several farms. In August 2017, a forest fire was erupted in the Municipality of La Granja de San Ildefonso, in the Autonomous Community of Castilla y León which threatened the Sierra de Guadarrama National Park.

Spain was also struck by heavy rains and storm. Starting from January 2015 floods in the Ebro river basin inundated many villages in the Zaragoza province. In April 2018, an extraordinary flood event occurred again in the Ebro basin due to the snow melting in the Pyrenees. The first flooded areas

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were registered in Castejón (Navarra) and the peak was in Zaragoza city. In October 2018, Costa del Sol and Malaga were hit by torrential rains. One firefighter died after heavy rains triggered flash floods. The strength of the waters overturned cars, overflown roads, damaged homes and forced hundreds of people to leave their properties. The torrential rain left Andalucian towns almost engulfed in water. In 2019 heavy rainfall with hails, winds up to 100km/h and huge waves effected the Southeast of the Iberian Peninsula, inundated many villages, and damaged infrastructures and buildings in the provinces of Valencia, Alicante, Murcia and Albacete.

The level of GDP is lowest or second lowest category in the most of fire-affected disaster areas (< €14 842). In the areas where flood take place the living standard is higher, exceeding even the second highest category in Barcelona region (€ 63 649 -132 914). The premises of the Salvation Army are in Madrid which has not suffered from disasters in the study area. However, the area boarders with fire disaster areas, and thus it is possible that some of the Salvation Army's clients could been affected.

2.1.4.11 Romania

In Romania, earthquakes took place in spring 2015 several times in Oraş Mãrãşeşti, 0.5 km northwest of Modruzeni, Vrancea (Figure 15).

In 2019 September in Ukraina near Romanian boarder salty waters threatened environment plus vicinity of the Tisza River and town of Solotvyno. A cross-border environmental disaster in Ukraine, Romania and Hungary was afraid to be happen if salty water reaches the Tisza River.

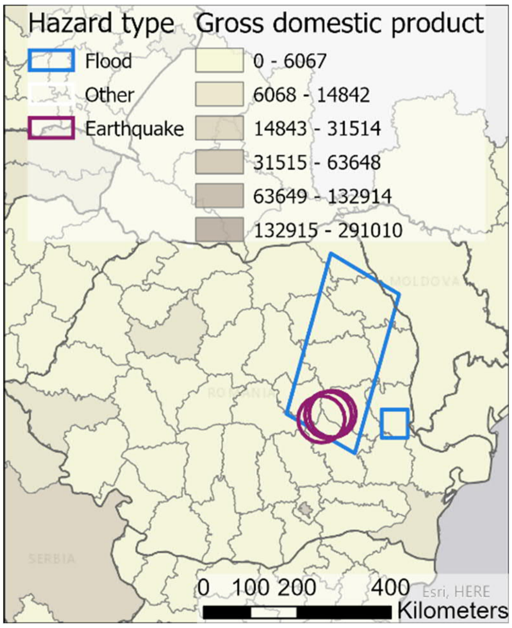

Figure 15: Hazards in Romania between 2015 and 2019 with SAL Cities in Green

As result of heavy rainfalls, flood warnings have been issued in October 2016 in Galati County with the risk of overflows of slopes, torrents, streams causing local flooding. Heavy rains caused flooding in several counties and blocked traffic on major roads. Particularly, in Galati County the road and railway traffic had suffered delays and stopped due to flooding.

In June 2018, a flooding event affecting the central and eastern parts of Romania. Heavy rain in recent days has caused floods in several areas in central and Eastern Romania. The Botosani, Trotus and Ozun areas are facing several floods, hundreds of people were evacuated.

The Salvation Army premises are located in Lasi and Ploiesti areas, from which Lasi is located in the north-east part of Romania near the Moldova Border, and Ploiesti is e located north of Bucharest.

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2.1.4.12 Denmark and the Netherlands

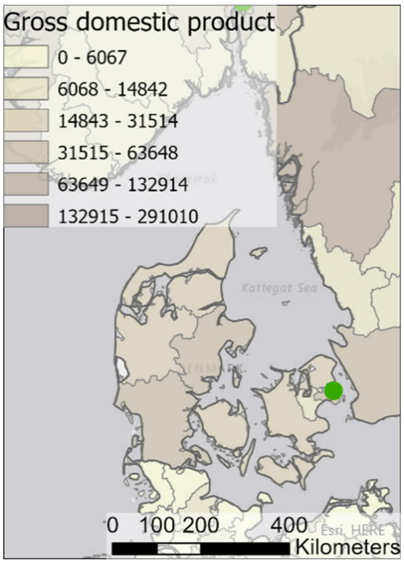

Figure 16: Hazards in Denmark between 2015 and 2019 with SAL Cities in Green

In Denmark (Figure 16) no natural or man-made disasters have been recorded during 2015-2020. Still it needs to be determined whether the Salvation Army's clients domiciled in Copenhagen have experienced any other adverse events in different countries.

The Salvation Army premises are in Copenhagen.

In the Netherlands (Figure 17) only one flood occurring in river Rhine is mentioned. The Salvation Army's service provisions premises are in Amsterdam, Groningen (placed in the figure 16), and in The Hague.

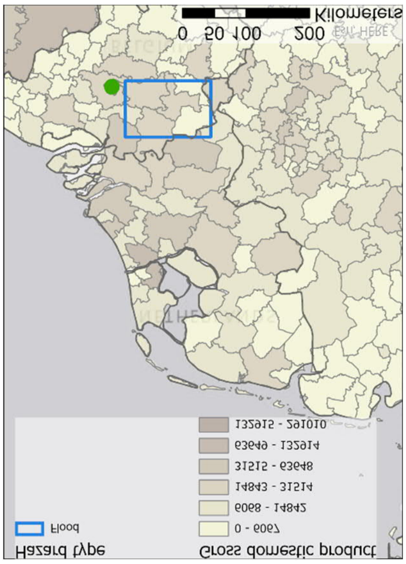

Figure 17: Hazards in the Netherlands between 2015 and 2019 with SAL Cities in Green

2.2 Conclusion from Review of Hazard Impacts on Selected Countries

The review of natural and other hazards that imperilled the social and functional stability of the European countries and imposed havoc on their people indicates that hazard exposure and consequences varied broadly. Also, the data indicate, that many subgroups from which the samples of respondents for participation in WP3 survey study will be drawn might become impoverished and pauperized by hazards disasters which hit the areas and regions of their settlement.

However, given wide economic wealth disparities among European countries, the magnitude of human and societal distress, the economic losses and physical devastation might more severely harmed those at the lowest stratum of societal hierarchy.

The northern European countries sustained fewer natural disasters as compared to those in the central Europe. The latter were tormented by severe storms and large-scale floods, which occasionally, had also stricken the Baltic and Nordic territories.

Yet, common for the northern, central and eastern European regions were the long spells of fatal heat waves and cold periods, which as shown in the forthcoming chapter, are quite noxious, particularly for people with fragile health. The southern European countries France, Spain, Italy and Portugal suffered not only from the lethal wildfires and earthquakes, but also from heat waves, and occasionally, from floods. In addition, some volcano eruptions did occur in Italy endangering livelihood of people in Sicily.

Data inspection indicates that the occurrence and types of natural hazards recorded here correlated well with the ambient and geo-structural features of climatological zones discerned by, among others, the EU_EWENT project in 2012 (see figure 18 below).

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The above review has high relevance for the validity of the survey study in Task 3.3. It exposes the regional disparities between hazards occurrences and impacts, thus indicating which traumatic experience the candidate informants might have lived through and how these stressors affected their welfare, life conditions and prospects in different geospatial and socio-economic contexts.

The Northern Region (light blue), is typically dominated by extreme winter phenomena with cold spells, heavy snowfalls and blizzards. **The Temperate Central Region (grey)** is less affected by extreme weather events than the other zones, but there is a 5% probability of heat waves (Tmax ≥ 32 °C), 2% of heavy rainfall (>30 mm/24 h) and on average 15-20 days/year with over 17 m/s wind gusts. Winters have occasional blizzards and sporadic severe snowfall especially over the southern part of this region.
In the **Temperate Eastern European Region (green)** cold spells are more frequent and intense during winter. Extreme cold spells are frequent over the eastern part as well as blizzards and heavy snowfalls.
The Oceanic Region (brown) features a relatively moderate frequency of extreme winter phenomena. The probability of heat waves is higher over the mainland while heavy rainfall and extreme wind gusts are more common over the British Isles. **The Mediterranean Sea (yellow)** and its coastal areas are affected, particularly in summer, by the highest frequency of heat waves in Europe. Locally, the frequency of thunderstorms and lightning as well as the intensity of heavy rainfall reach high levels. Frost days and snowfalls may occur on an annual basis.
Due to the topography of the **Mountainous Region (white)** these regions can have remarkably different extreme phenomena from their surroundings. The most characteristic extreme phenomena affecting this area are cold spells, heavy snowfall, blizzards, and especially in the Scandinavian mountains and the Alps heavy rainfall

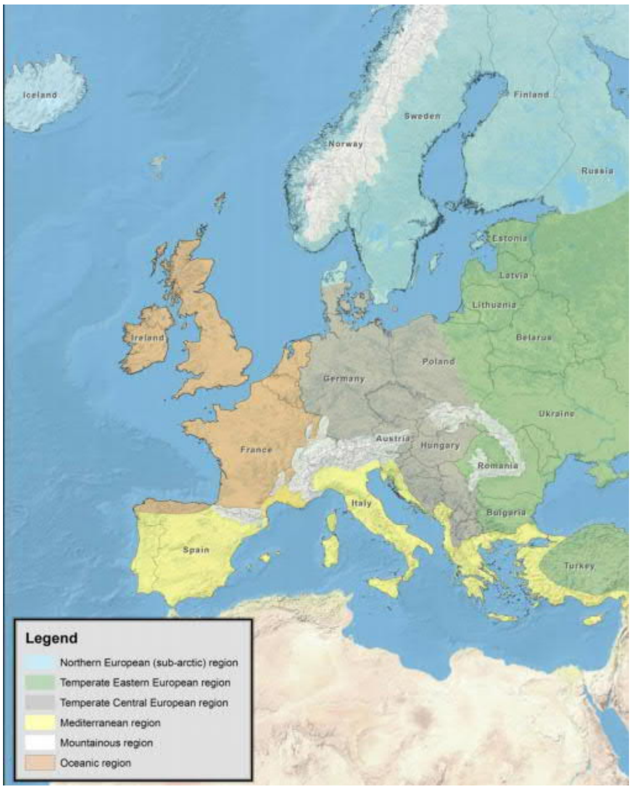

Figure 18: The European climatological zones
Source: Risk Panorama, EWENT project, 2012

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3. HAZARDS IMPACTS

3.1 Mortality Due to the Disasters

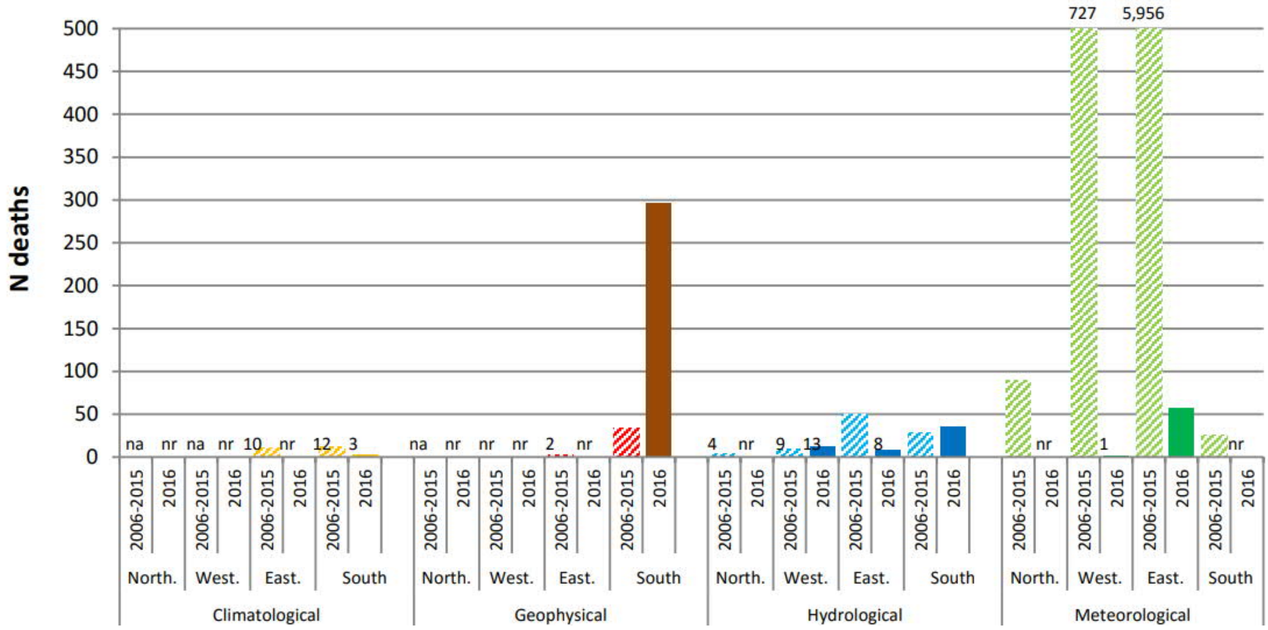

Figure 19: Number of deaths by disaster type. Mean 2006-2015 vs. 2016. na= not available, nr; no disaster reported
Source: Guha-Sapir, et al 2017

As presented in Figure 19, in 2013 a heat wave killed 760 people in the United Kingdom, which is alone about 86 % of the total number of deaths caused by natural disasters in Northern Europe for the period 2006 to 2015. In Western Europe the annual average is 727 deaths from meteorological disasters, which is explained by two heat waves in 2006 and 2015 resulted in 3 340 and 3 685 deaths. In Eastern Europe the annual death rate is far higher, 5 956 deaths on average. It comes from the 55 736 deaths due to heat wave in the Russian Federation in 2010.

As for the geophysical disasters, the annual average of 34 deaths in Southern Europe comes from the L'Aquila earthquake. It took place in 2009 and caused 295 peoples' death. Also, in 2016, the Amatrice earthquake caused death of 297 people. Both earthquakes took place in the same region of Italy.

3.1.1 People Affected by Disasters

Disasters that affect at least one million people are very rare in Europe. During the period from 2006 to 2015, only three large disasters were identified: a wildfire in Macedonia in 2007, one flood in the Czech Republic in 2013, and another flood in Bosnia-Herzegovina in 2014. Only six disasters affected more than 100 000 people, and most of the disasters affected far under 50 000 people (Figure 20).

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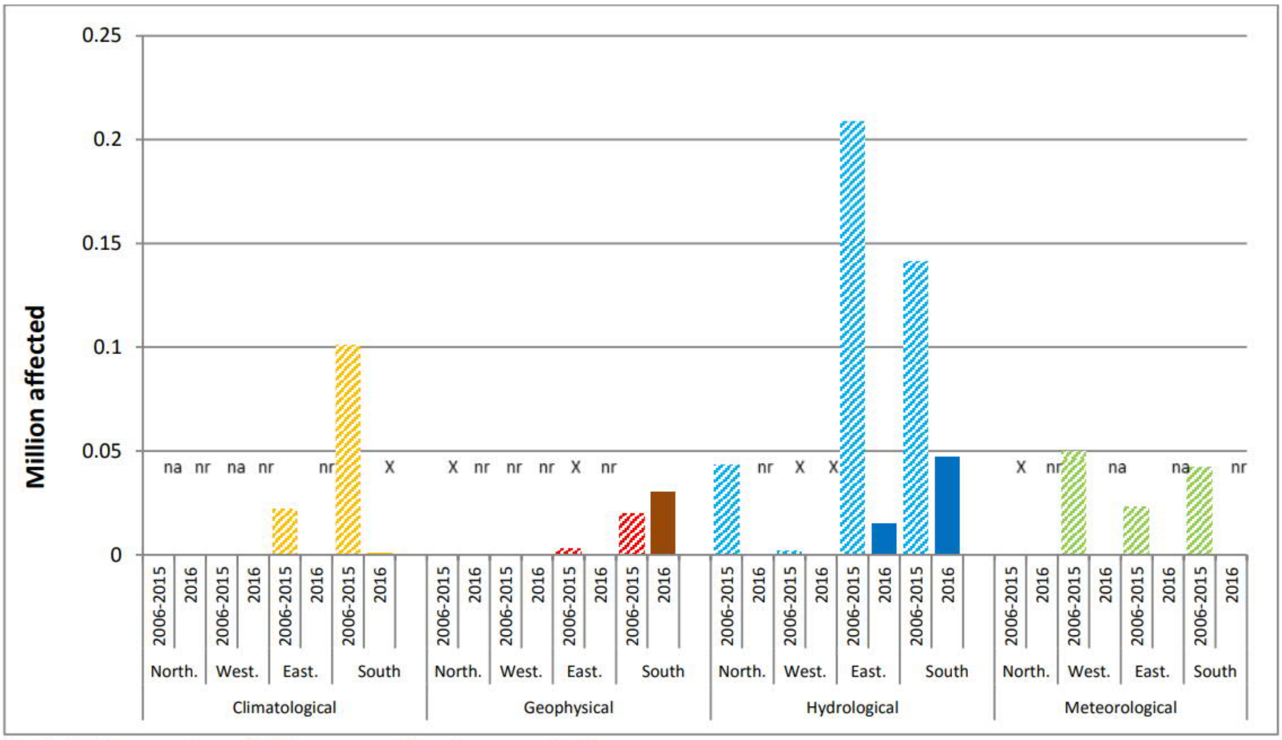

X:< 0,005; na: not available; nr: no disaster reported

Figure 20: Number of people reported affected by disaster type in Northern, Western, Eastern and Southern
Source: Guha-Sapir, et al 2017

Due to rare climatological disasters in Northern and Western Europe also the data on the numbers of people affected are not reported exactly. In Eastern Europe, more than 200 000 people affected by a drought in Moldova in 2007. In Southern Europe, a wildfire in Macedonia in 2007 has reported to affect even one million people while in Portugal only 1 161 people suffered from a wildfire in 2016. Usually, severe climatological disasters affected about 6 000-7 000 people in Southern Europa.

Floods have the most negative impacts on people in Europe. During the period 2006-205, in Northern Europe floods affected over 43 thousand people on average. The flood in UK 2007 alone, affected 340 000 people. At the same period, in Western Europe, the biggest flood affected only 6 350 people, while in Eastern Europe, the biggest flood in Czech Republic 2013 affected 1.4 million people. In Southern Europe, the annual average is more than 140 000 people due to the flood in Herzegovina in 2015 affecting one million people.

What concerns meteorological disasters, people in Northern and Western Europe suffer from storms. Due to that, the annual average number of people affected in the Northern Europe reached around 4 000 people and 50 000 in Western Europe. In Eastern and Southern Europe, the extreme temperatures have most effects on habitants. In Eastern Europe the annual average of 23 454 people is related to one cold wave, which struck on six countries in 2012, affecting 105 000 people. Also, in Southern Europe over 340 000 people were hit by the cold wave during the same year.

3.1.2 Economic Costs of Disasters

Between 2006 and 2015, meteorological disasters cost an annual average of 281 million US$ in damages in Northern Europe. Most costs resulted from storms Kyrill and Desmond in 2007 and 2015, which cost 1.4 and 1.2 billion US$, respectively. In Western Europe, the storm Kyrill in Germany in 2007 cost 6.3 billion US$, Klaus and Xynthia in France in 2009 and 2010 cost 3.6 and 4.6 billion US$,

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respectively, and one convective storm in Germany in 2013 cost 4.9 billion US$ in damages. In 2016, one convective storm cost 844 million US$ in the Netherlands. In Eastern Europe, the 2006-2015 annual average includes damages from extreme temperature periods and from storms. In Russia, one extreme winter episode cost 1.2 billion US$ in 2006, and a heat wave around 440 million US$ in 2010.

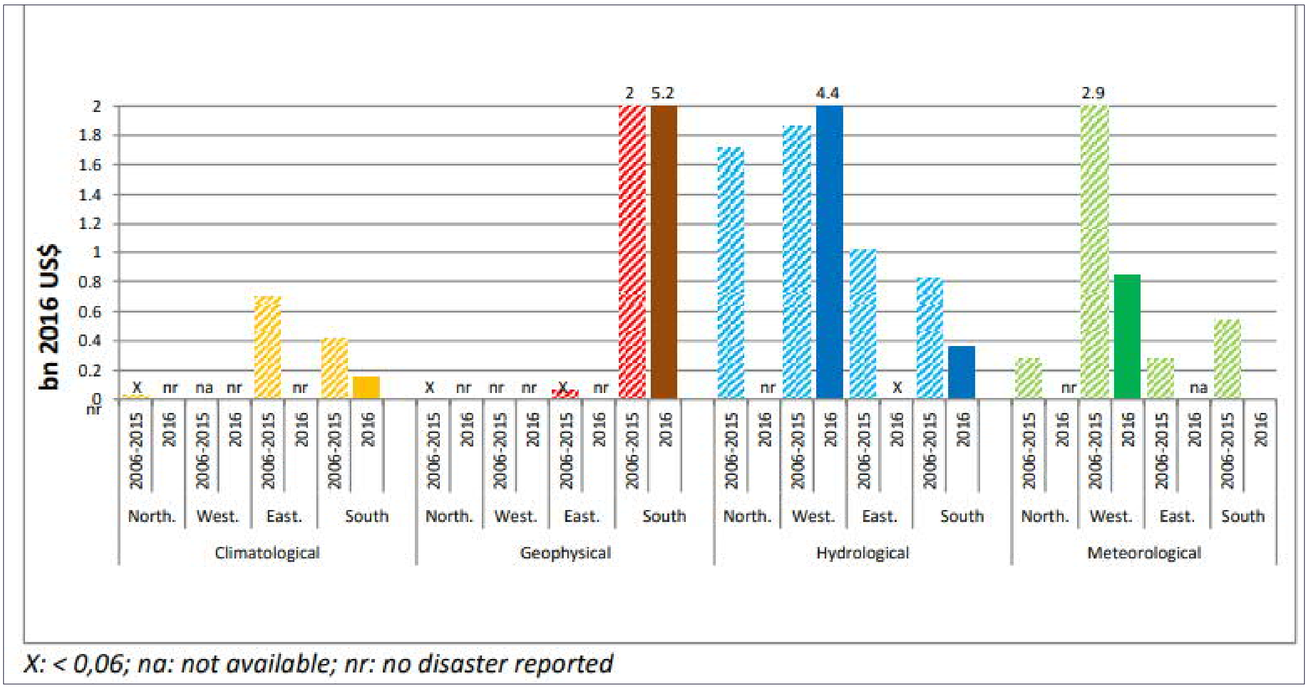

Figure 21: Number of people reported affected by disaster type in Northern, Western, Eastern and Southern

Source: Guha-Sapir, et al 2017

As shown in the Figure 21, most of the costs in Southern Europe occurred due to geophysical disasters and in Western Europa due to hydrological events. The climatological and hydrological events are most expensive in Eastern Europe, while hydrological events in the Northern Europe.

In Southern Europe, annual average of damages from earthquakes was 2 billion US$. This comes mostly from the two earthquakes in Italy in 2009 and 2012 with 2.8 and 16.4 billion US$ damages.

In Northern Europe, five floods in the UK caused huge costs. Two floods in 2007 cost both 4.6 billion US$. The other three in 2012, 2014 and 2015 caused 4.7, 1.5 and 1.2 billion US$ damages.

In Western Europe, the 1.87 billion US$ annual average in costs comes mostly from four floods in France in 2010 (1.6 bn. US$) and 2015 (0.9 bn. US$), and one in Germany (13.2 bn. US$) and in Austria (1 bn. US$) in 2013.

In Eastern Europe the annual average of 1.01 billion US$ damages from floods is mostly attributed to four events: one in Ukraine in 2008 (1.1 billion US$), two in Poland and Romania in 2010 (3.4 and 1.2 billion US$, respectively) and one in the Russian Federation in 2013 (1 billion US$).

In Southern Europe, the annual average of 823 million US$, is mainly due to two major floods in Portugal in 2010 and Serbia in 2014, costing 1.5 and 2.1 billion US$, respectively. Other costly floods took place in 2014: one in Bosnia-Herzegovina with 440 million US$ in damages and four in Italy with over 800 million US$ each.

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Between 2006 and 2015, meteorological disasters cost an annual average of 281 million US$ damages in Northern Europe. Most costs resulted from storms Kyrill and Desmond in 2007 and 2015, which cost 1.4 and 1.2 billion US$, respectively. In Western Europe, the before mentioned storm Kyrill caused in Germany 6.3 billion US$ costs. Other storms Klaus and Xynthia caused in France 3.6 and 4.6 billion US$ costs. In Southern Europe, the storm Klaus cost 2.12 billion in damages in Spain.

In Eastern Europe, four storms strongly influenced the annual average of damages: 550 million US$ from a hailstorm in Bulgaria in 2014, the 2007 extra-tropical storm Kyrill cost 170 million US$ damages in the Czech Republic and 115 million US$ in Poland and Ukraine. In Southern Europe, in Italy, a cold wave cost 140 million US$ in 2012.

3.2 Economic damages and life losses attributed to natural hazards in EU and EEA member states 1980-2017

This chapter presents data on economic losses from climate-related extremes in Europe provided by the European Environmental Agency https://www.eea.europa.eu/data-and-maps/indicators/direct-losses-from-weather-disasters-3/assessment-2, and the data was last retrieved in October 2020.

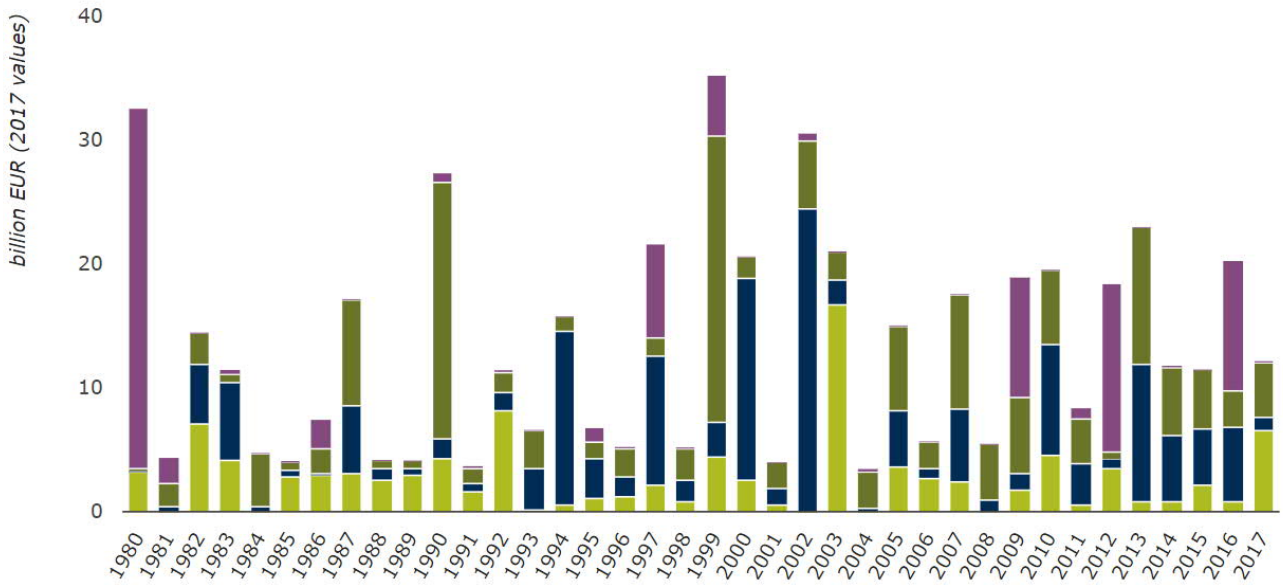

Figure 22: EU28 - Economic Damage Caused by Weather and Climate-induced Events in Europe 1980-2017
Source: EEA, 2020

The data provided by the European Environment Agency (EEA), shows the recorded economic losses from weather and climate-related extremes varied substantially over time and that no clear trend could be identified (Figure 22). The average annual economic loss (inflation-corrected) was around € 7.4 billion per year in the 1980, € 13.4 billion in the 1990s, and € 14.0 billion per year in the 2000s (2000-2009). In the last period 2010-2017 the average annual economic loss amounted to around € 13.0 billion (EEA 2020).

EEA classifies the climate-related extremes in four categories: geo-physical events (earthquakes, tsunamis, volcanic eruptions), meteorological events (storms), hydrological events (floods, mass movements), and climatological events (cold waves, heat waves, drought, forest fires, pluvial precipitation) (see Figure 23).

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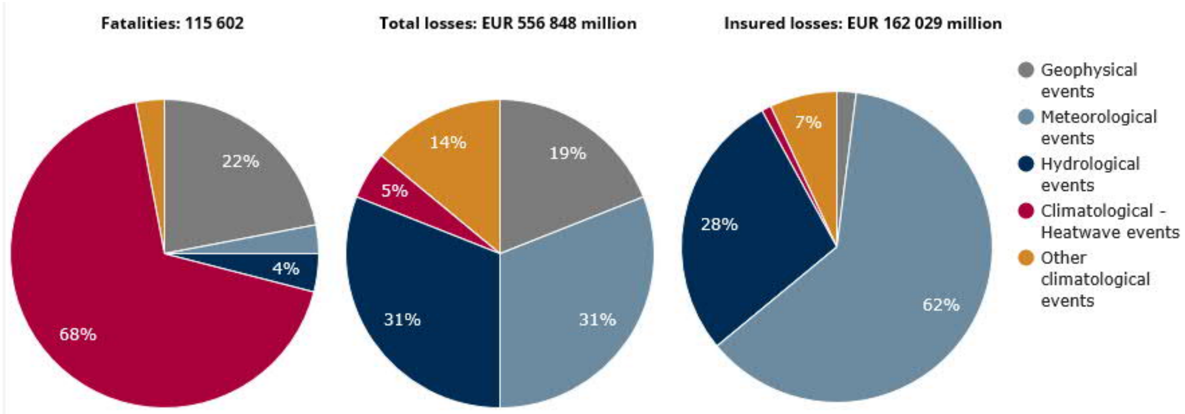

Figure 23: Fatalities, Total Losses and Insured Losses in EU and EEA Member States 1980-2017.
Source: EEA, 2020

During the period 1980-2017, over 115 00 people died in natural disasters in EU and EEA countries. The economic losses from these disasters amounted to € 557 billion and the insured losses were approximately € 162 billion (in 2017 values).

Meteorological and hydrological hazards were responsible for 62% of the total losses and for 80% of insured losses. It needs to be noted, that increases in the economic wealth over the analysed period had major effect on amount of annual losses.

In the EU Member States (EU-28), disasters caused by weather and climate-related extremes accounted for some 83 % of the monetary losses over the period 1980-2017. Weather and climate-related losses amounted to € 426 billion (at 2017 values).

As shown in Table 3 below, the distribution of weather and climate-related loss categories among the EU and EEA 33 member-countries is uneven. The biggest overall economic losses in absolute terms (in order of rank) were suffered by Germany, Italy and France. Yet, France has registered the highest number of fatalities - 23 415 – attributable to climatic hazards, Italy – 20 557, Spain 14 611 and Germany 9 856.

The most expensive climate extremes in the EU Member States include the 2002 flood in Central Europe (over € 21 billion), the 2003 drought and heat wave (almost € 15 billion), and the 1999 winter storm Lothar and October 2000 flood in Italy and France (both € 13 billion), all at 2017 values.

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Table 3: Economic Losses and Fatalities Attributed to Extreme Weather and Climate-related Events on the EU and EEA

Countries. 1980-2017.

Country	Losses (million Euro)	Loss per capita (Euro)	Loss per sq.km (Euro)	Insured losses (million Euro)	Insured losses (%)	Fatalities
Austria	13 489	1 681	160 818	4 156	31	595
Belgium	4 308	415	141 125	2 531	59	2 168
Bulgaria	2 452	302	22 217	129	5	205
Croatia	3 014	674	53 256	74	2	722
Cyprus	386	565	41 760	8	2	77
Czechia	10 533	1 018	133 551	3 554	34	220
Denmark	10 336	1 936	240 838	6 307	61	42
Estonia	108	76	2 387	33	31	9
Finland	1 959	380	5 789	397	20	4
France	62 059	1 026	98 011	30 961	50	23 415
Germany	96 494	1 271	270 008	45 188	47	9 856
Greece	7 319	693	55 424	113	2	2 431
Hungary	6 035	588	64 881	137	2	703
Iceland	88	312	850	43	50	52
Ireland	4 014	1 017	57 515	2 059	51	69
Italy	64 673	1 120	214 099	2 918	5	20 657
Latvia	412	175	6 380	49	12	103
Liechtenstein	6	182	36 212	3	58	0
Lithuania	976	288	14 943	7	1	69
Luxembourg	718	1 627	277 817	424	59	130
Malta	63	163	197 984	26	41	7
Netherlands	8 111	517	195 240	3 771	46	1 729
Norway	3 597	794	11 110	1 977	55	40
Poland	15 057	397	48 155	1 027	7	1 217
Portugal	6 869	672	74 475	584	9	3 108
Romania	11 065	508	46 414	60	1	1 310
Slovakia	1 669	314	34 045	106	6	112
Slovenia	1 690	846	83 368	203	12	241
Spain	37 106	889	73 341	4 508	12	14 611
Sweden	4 272	479	9 741	1 165	27	46
Switzerland	18 805	2 609	455 431	9 621	51	1 160
Turkey	4 405	70	5 622	635	14	1 682
United Kingdom	50 504	848	203 208	35 106	70	3 535

Source: EEA 2020.
Note: For the period 1980-2017, figures are in EUR prices based on damage records from the NatCatSERVICE and EUROSTAT structural indicators.

According to the EEA, the heat and cold waves were responsible for 68% of 602 fatalities (115) during 1980-2017. The second dangerous hazards were geophysical events (e.g., earthquakes and other ground movement calamities such as ground-and/or- rockslides). The heat waves in 2003 causes around 13 000 fatalities as excess deaths during that hot summer.

Munich Re has studied the number of people killed by the different types of weather and climate-related events (2017). Figure 24 shows that the most injurious natural hazards in Southern and Western Europe were heat waves, while in Eastern Europe, the number cold spells. The most severe impacts in Northern Europe have come from heat waves. However, these effects in Northern Europe have been minor compared to France, Italy, Spain and UK.

Data on value of economic losses per square km inflicted by extreme weather and climate-related events during 1980-2019 compiled by European Environmental Agency show that Germany, Austria, Switzerland and Italy were hit the most although material damage was also severe other countries (figure 25).

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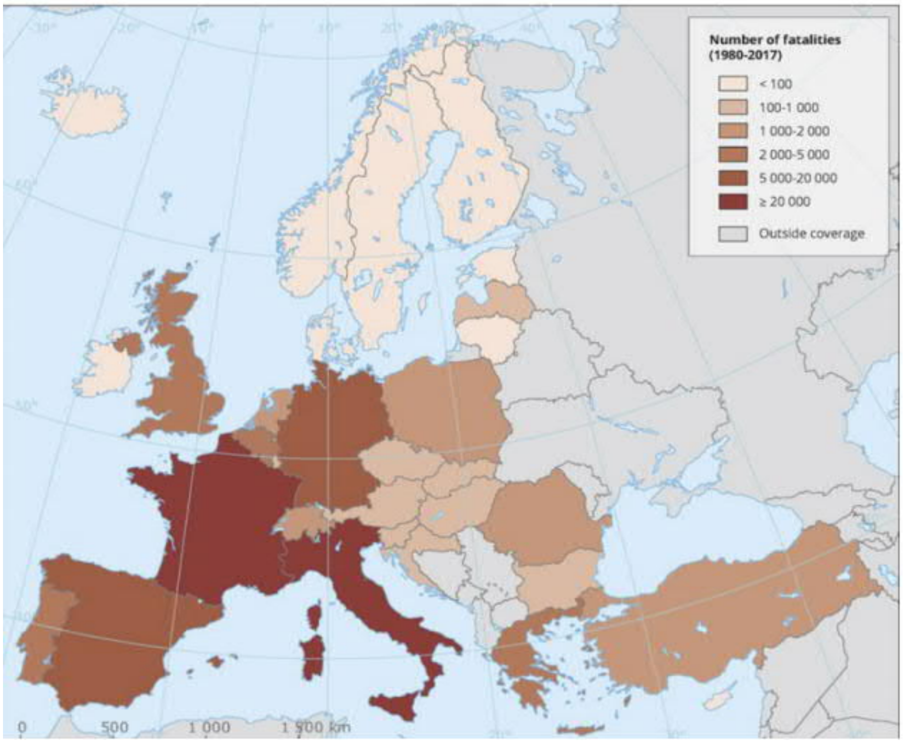

Figure 24: Fatalities in Extreme Weather and Climate-related Events (1980-2017)
Source: Munich RE/EEA, 2020

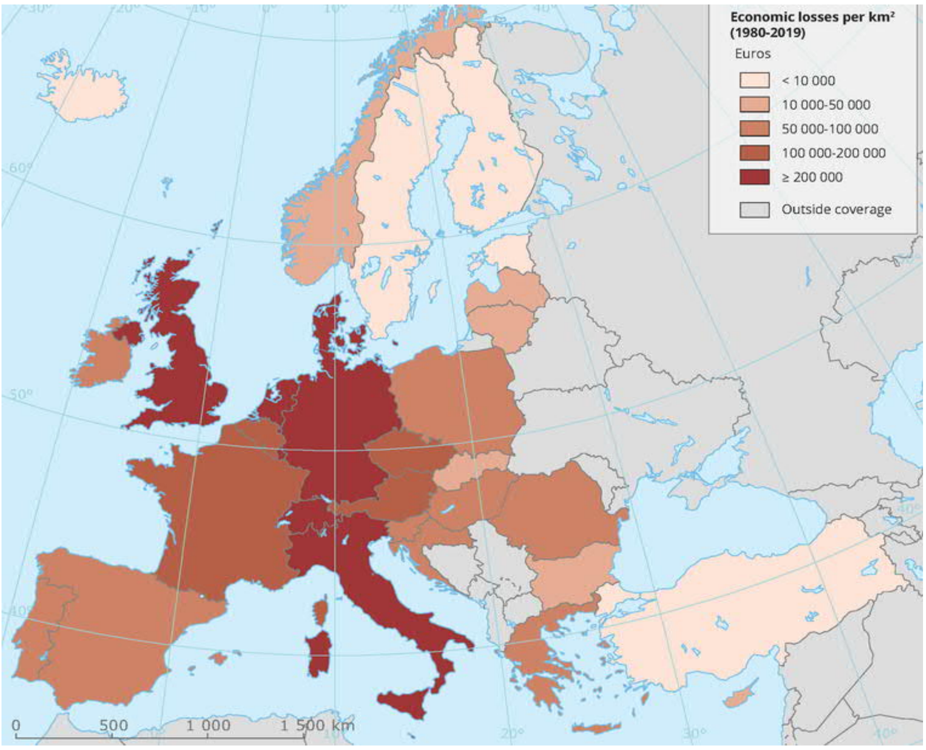

Figure 25: Impact of Extreme Weather and Climate-related Events on Economic Losses per Square Kilometer in the EEA Member Countries (1980-2019)
Source: EEA, 2020

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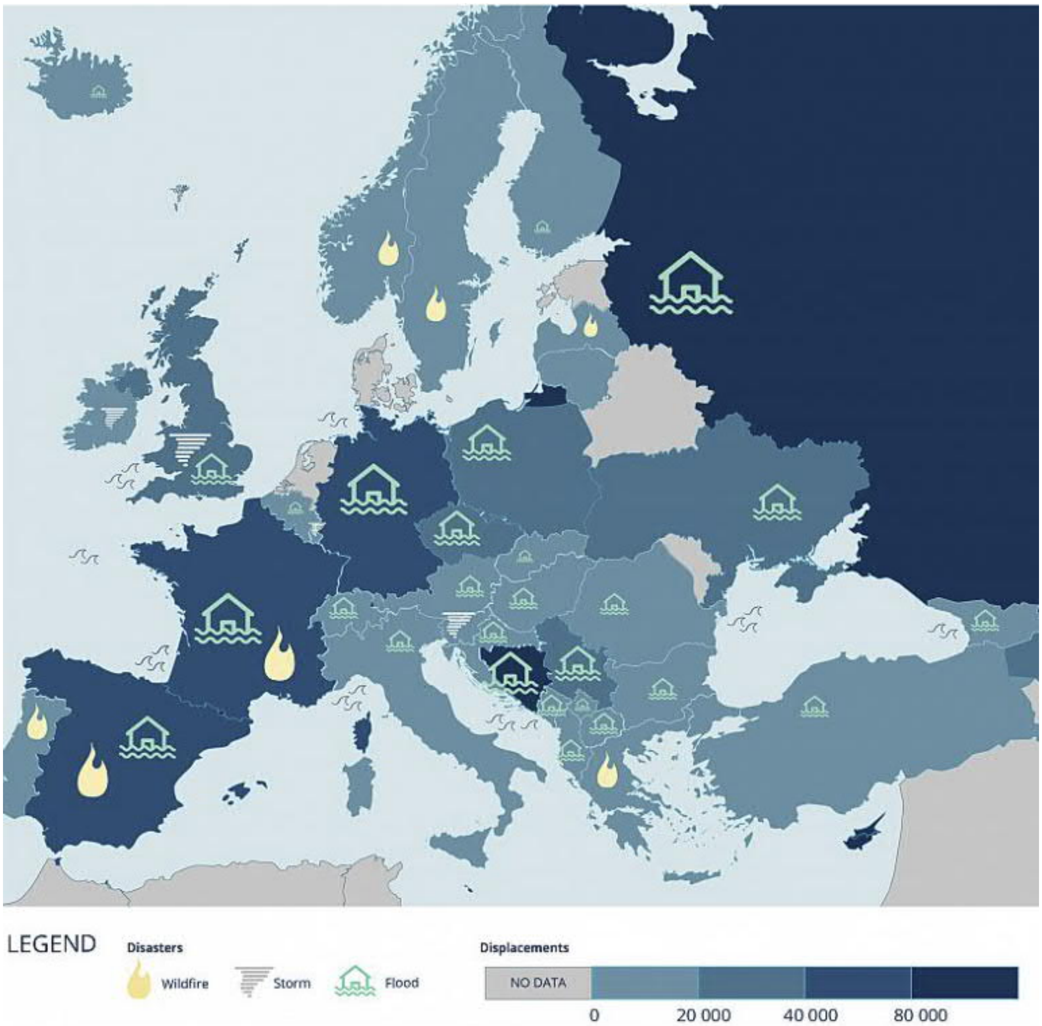

Figure 26: Displacement in Europe by Weather Events (2008-2019)
Source: IDMC, Global Data Base for Europe and Turkey (2019 preliminary figures)

Figure 26 shows that fires and floods are the most severe disasters which drive many Europeans away from their home base and turn them into migrants. Fire scorches and flooding ravages devastate economic assets, critical infrastructure and industrial base and deprive many citizens of jobs and subsistence. The map above shows that Spain, Greece and France suffered the most among the countries reviewed from economic damages inflicted by floods and fires. These cataclysms forced many Greek, Spanish and French citizens into displacement. Germany suffered also from flood-inflicted displacement as did Portugal, the Czech Republic, Poland, and South-eastern and Balkan countries, although at smaller scale.

These data confirm the findings from the CRED study:

1) The most recurrent and harmful natural hazards in the Europe are extreme heats and colds, fires, floods and earthquakes.
2) Natural hazards hit with a various intensity the different parts of Europe. They affect less Northern Europe than other European territories.
3) The identified natural disasters hit large areas and imposed severe human, economic and social scars on population affected. However, those who did not have homes at all, or their homes were not capable to withstand the hazard stressors, or where the infrastructures were damaged, these people might have been harmed the most.

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3.3 Impacts of fire hazards on population in some EU countries

3.3.1 Wildfire Events and Casualties

The fire hazards became more frequent over the last decade with scaler of damage and severity increasing as well. Below the scale and the scope of these calamities and the harms they have imposed on populations and the severely vulnerable social groups are reviewed in several EU nations.

Data in Table 4 below reveal that Portugal was the EU country, which in 2018 has suffered most from large numbers of forest fires invoked by the staggering 12 436 blaze cases. Portugal's negative fire record were followed by Poland (8 867), Sweden (8 181) and Spain (7 143). As the size of burnt forest areas in Portugal accounted for 540 639 hectares, its citizens have also suffered from the largest scale, severity and intensity of blaze in the EU. However, the scale of fire damage as measured by the number of forest hectares burnt was also high in Spain (178 234), Italy (161 987) and Greece (13 393). Poland was affected by 3 953 blaze disasters, Hungary by 1 454 and Greece by 1 083.

Table 4: Number of Fires and Burnt Areas Reported by EFIS countries in 2018
Source: San-Miguel-Ayanz, J, et al., 2019)

Country	Number of fires			Burnt area (ha)			Notes
	2018	2008-17 average	2018 as % of average	2018	2008-17 average	2018 as % of average	
Austria	**159**	207	77	**19**	72	26	Change in method of recording fires
Bulgaria	**222**	471	47	**1453**	5315	27	
Cyprus	**131**	100	131	**1136**	1720	66	
Czech Rep.	**2033**	974	209	**492**	272	181	
Germany	**1708**	700	244	**2349**	333	706	
Algeria	**797**	3313	24	**2312**	36361	6	Average 2011-17
Spain	**7143**	12573	57	**25162**	101411	25	
Finland	**2427**	1141	213	**1228**	485	253	
France	**3005**	3791	79	**5124**	11923	43	
Greece	**793**	1055	75	**15464**	28208	55	
Croatia	**54**	229	144	**48543**	9064	536	
Hungary	**530**	1068	50	**906**	4882	19	
Italy	**3220**	5853	55	**161987**	78898	205	
Lebanon	**41**	125	33	**643**	883	73	Only 3 previous years to compare
Lithuania	**211**	180	117	**110**	107	103	
Latvia	**972**	525	185	**2864**	346	827	
Morocco	**343**	464	74	**841**	2964	28	
Netherlands	**949**	-	-	**572**	-	-	New contributor
North Macedonia	**19**	247	8	**95**	4703	2	
Norway	**887**	123	722	**3279**	882	372	Change in method of recording fires 2016
Poland	**8867**	7163	124	**2696**	3143	86	
Portugal	**12436**	18485	67	**43702**	136107	32	
Romania	**158**	267	59	**1341**	1581	85	
Slovenia	**32**	91	35	**20**	278	7	
Slovakia	**262**	240	109	**248**	419	59	
Sweden	**8181**	4115	199	**24310**	2911	835	
Switzerland	**153**	92	166	**69**	110	62	
Turkey	**2167**	2385	91	**5644**	9075	62	
Ukraine	**1297**	2186	59	**1367**	4036	34	

Source: JRC Technical Report: "Forrest Fires in Europe, Middle East and North Africa" (2018), EU 29318 EN, p U 29318EN, p. 10.

Figure 27 shows the pattern of spatial distribution of wildfires in the Southern Europe with the number of fatalities recorded during 1945-2016. The study of Molina-Terrén et al. (2019) states that Spain has

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recorded a higher number of the deaths concentrated in Catalonia and the Valencian community near Mediterranean coast, where 37.5% of the death occurred. However, these two regions comprise only 16.2% of the burned surface area. In Portugal, the most of fatal incidents occurred in the central and northern regions. In Greece, 59.7% of the fire deaths took place in the southern part of the country, where the climate is warmer and less humid. In Sardinia, more than 85% of fatalities were recorded in the northern part of the island.

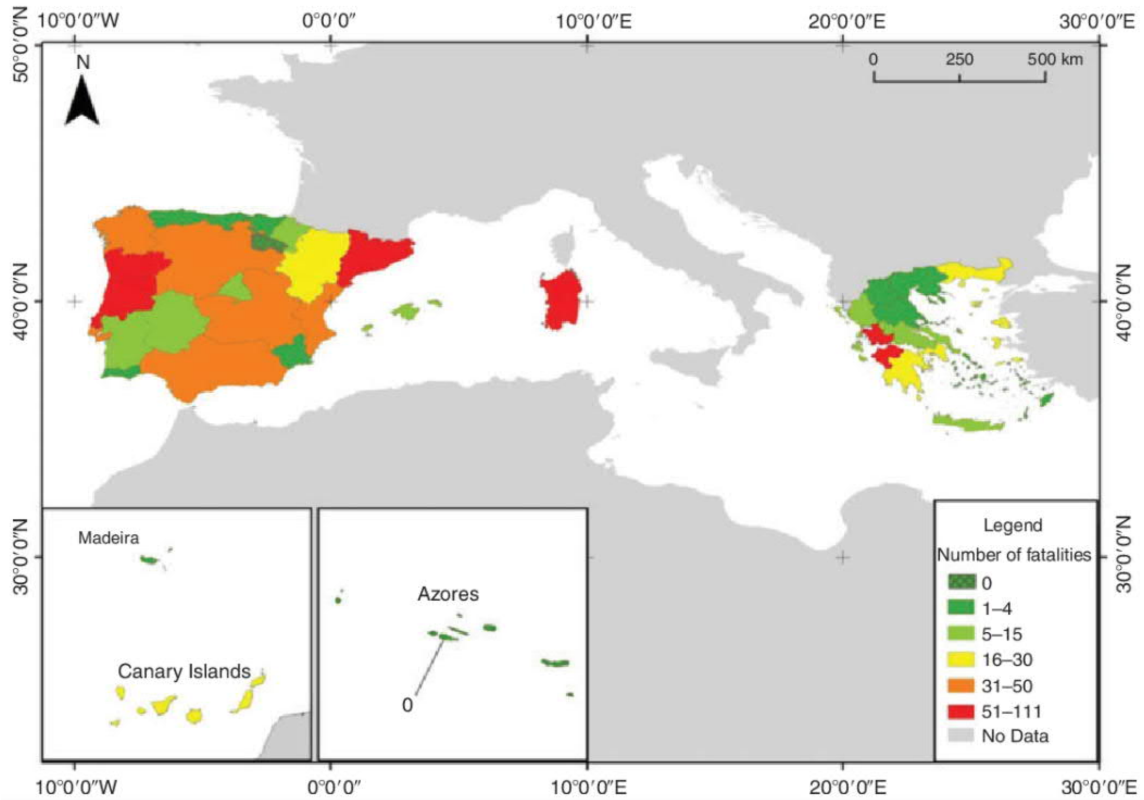

Figure 27: Spatial Distribution of Wildfire Fatalities in Each NUTS2 Region in Spain, Portugal, Greece, Sardinia (Italy) 1945-2016
Source: Molina-Terrén et al., 2019

Out of 686 fatalities, 42.3% were citizens (366 civilian persons), and the rest were fire brigade professionals or volunteers fighting the fires. In Greece and Sardinia, the most affected groups were civilians; 65% if Greece and 58% in Sardinia (58%). In Spain and Portugal, the professional firefighters were the most harmed groups. Most of the victims in these fires were understandable men. The age segment showed that in Portugal and Greece about 30% of the victims were over 65 years old, while in Spain this cohort was 14% and in Sardinia, about 8%.

The study reveals that although majority of victims (49.6% in total) are professionals or volunteers fighting fires, the number of civilians among the victims is high (42.3%). Thus, there is the increased risk of life loss for the people who either are professional fire fighters or happen to be trapped within the fire site. The risk is bigger for the elderly, children and people with disabilities who are not able to flee the hazard epicenter on their own.

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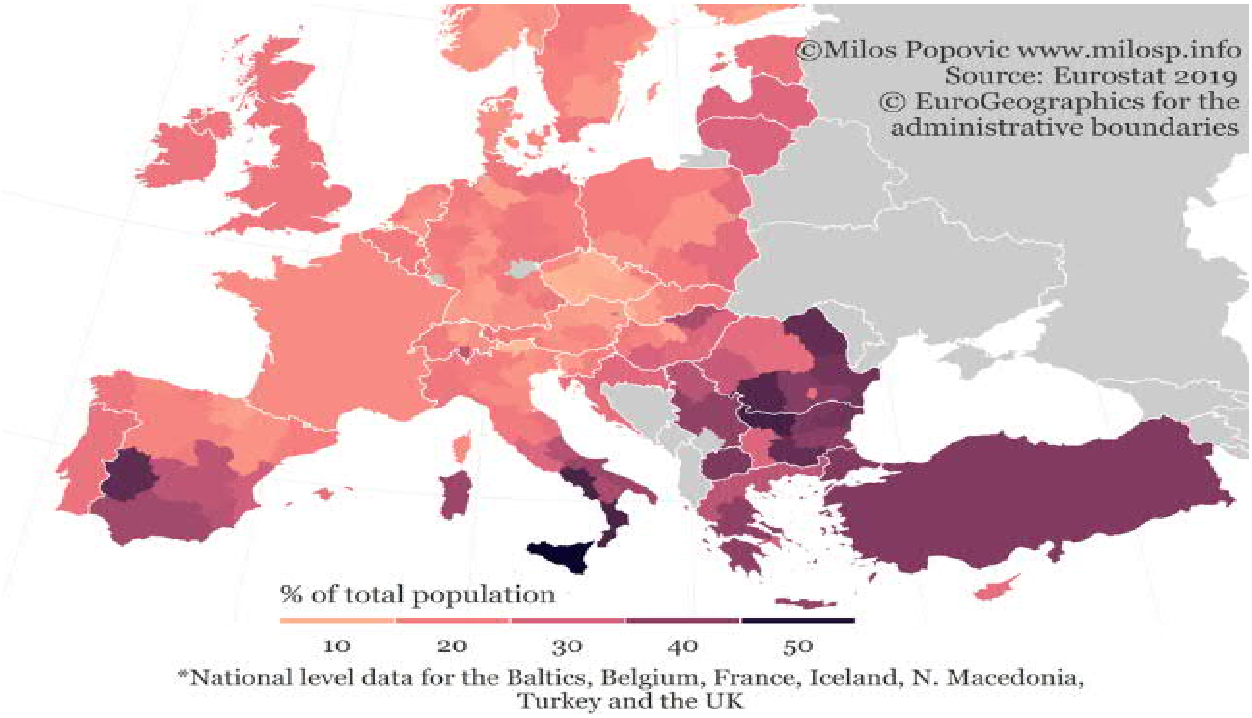

Figure 28: People at Risk of Poverty or Social Exclusion in EU Member Nations NUTS 2 Regions, 2017
Source: Eurostat 2019

Comparison of data in Figure 27 and Figure 28 indicates that the highest numbers of fatalities attributed to wild fires in Spain, Portugal, Greece and Sardinia during 1945 - 2016 occurred in regions where higher share of population were at the risk of poverty and social exclusion in 2017.

With 700 000 hectares of burnt land, the year 2017 was one of the most devastating for the EU countries. Data from the European Forest Fire Information (FFFI) indicate that nearly all wildfires were human originated, and very few were ignited by natural lightning. However, the hot and dry conditions induced by climate change resulted in more severe fires and higher frequency of small fires to become uncontrollable, thus creating severe danger to human lives and livelihood. Toxic smoke from these fires left many people severely harmed or even dead.

Map below (Figure 29) shows the fires during the fire season 1st of January to the 2nd of May in 2019. As seen, the northern regions of Spain and Greece as well as South Italy suffered considerably from wild and forest fires. The map shows also the built areas in colour, which indicates that especially in Portugal fires blazed the built areas.

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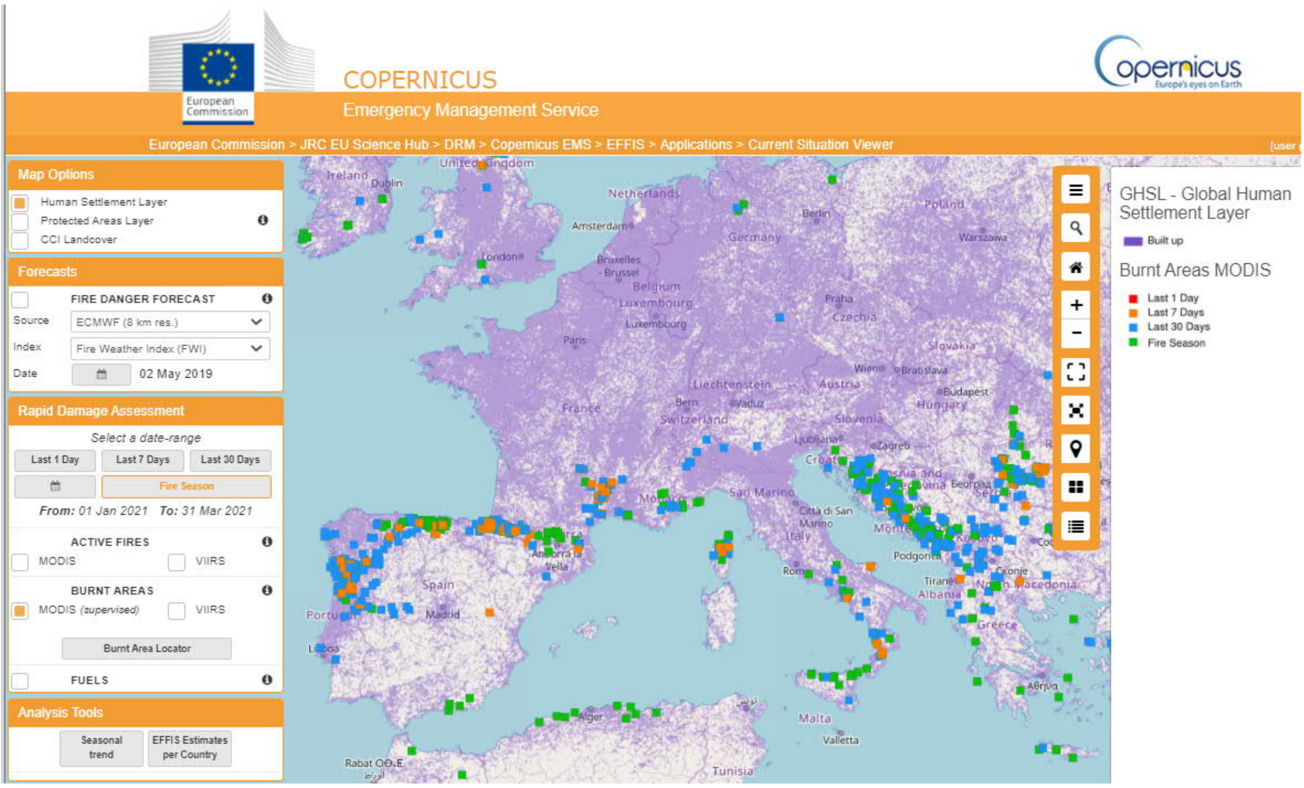

Figure 29: Fires in Europe during the Fire Season 1st of January to the 2nd of May in 2019
Source: Copernicus service

It is important to notice that in 2017, 110 people have perished in Portugal alone from wildfires while 100 people have been killed in Greece in 2018 (Climate Change Post, 2019). In year 2019 a vast explosion of hazard areas hit countries where the long-lasting wildfires were not so common in the past, such as Sweden, Latvia, Germany and UK. Populations in these countries suffered from severe wildfires both in 2018 and 2019.

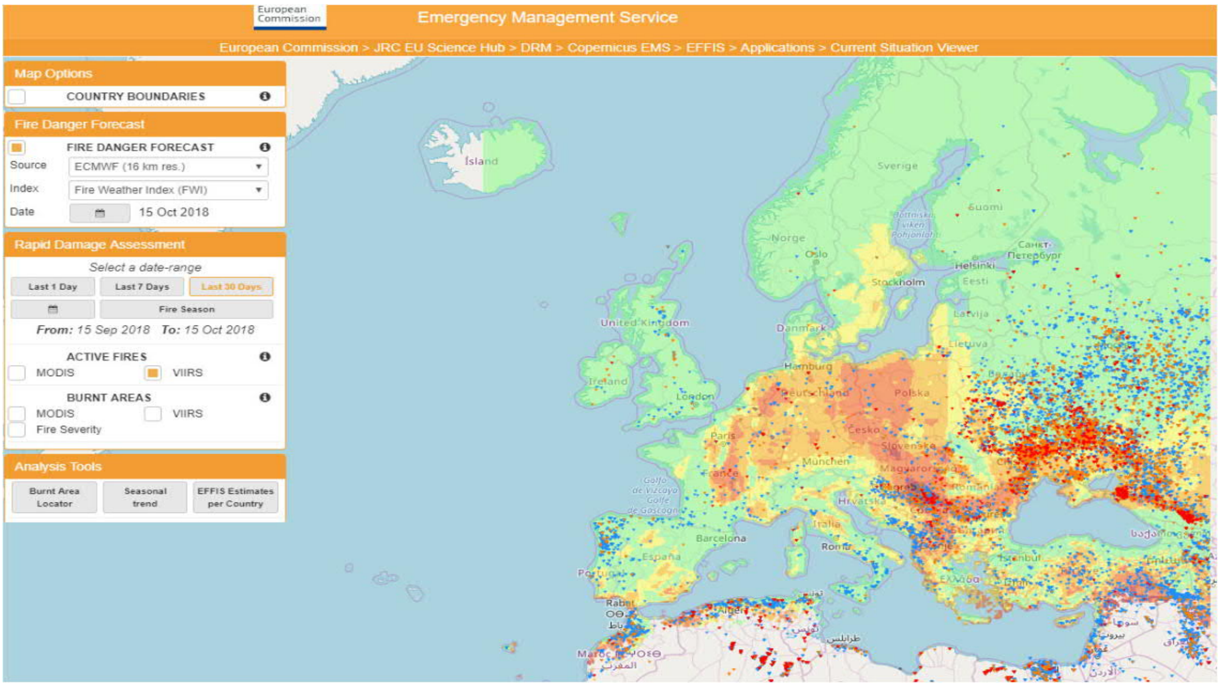

Figure 30: Map of Fires that Lasted from 1 to 30 Days between 15 September and 15 October 2019
Source: Copernicus Images at https://emergency.copernicus.eu/

Figure 30 shows that northern regions of Spain, southern France, West Balkan, and Greece suffered considerably from long-lasting wild and forest fires. Map in figure 13 below indicates that during the autumn 2019 fire disasters lasted longer in Southern, Central and Eastern Europe. They have been quelled in the Northern European territories, but not in the UK.

Below in Figure 31, an evolution in trends of burnt areas (ha) in Europe per week from 2008 to 2018 is shown along the growth in number of hectares burnt until 14 May 2019. It shows that the warmer winter and spring time has increased the burnt area especially during the period from February to May.

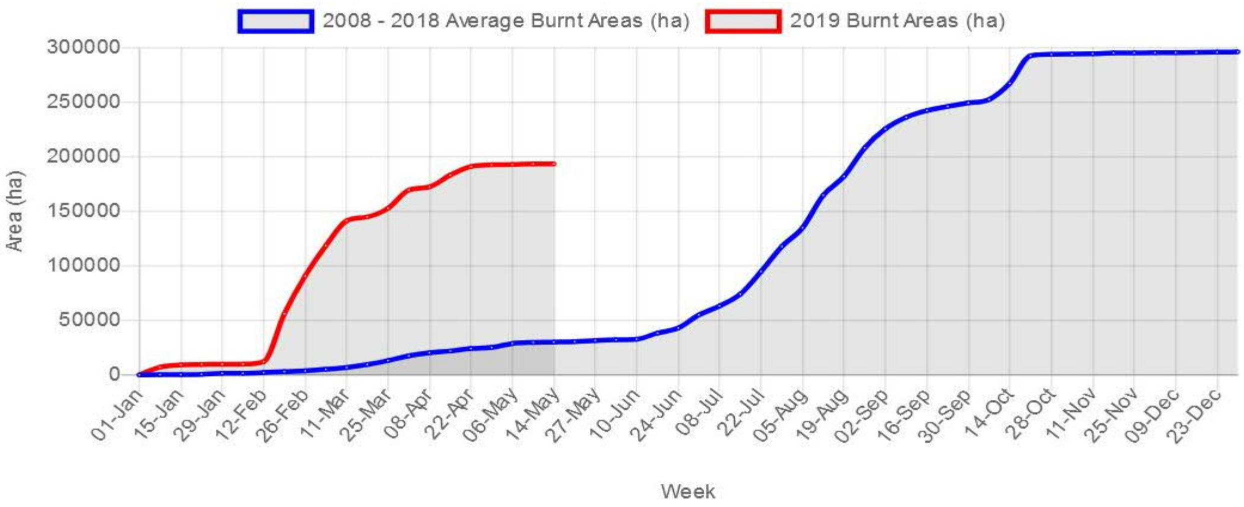

Figure 31: The Visualization of EFFIS Data Show the Spread of Fire Damage across the EU during 2019 and over 2008-2018
Source: http://effis.jrc.ec.europa.eu

3.3.2 Other fires and their Consequences

To gain more insights into the damage by fire disasters measured by the number of civilian deaths and injuries in several EU countries, data from the World Fire Statistics were collected and analysed (see Table 5).

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Table 5: Fire Statistics: Population size, Number of Firefighter Calls (Including False Calls), Number of Fire Incidents (Structural, Forest, Vehicle, Rubbish and Other), Deaths and Injuries Attributed to Fires in Selected EU Countries in 2017

No	EU country	*Population thousand inhabitants*	Number of			
			firefighter calls	**fires**	**fire deaths (civilians)**	**fire injuries (civilians)**
1	France	66 628	4 658 600	306 600	277	1 226
2	Great Britain	63 786	687 413	199 894	325	8 897
3	Italy	61 000	1 00 071	325 941	288	-
4	Spain	46 570	335 317	130 915	212	-
5	Poland	38 416	519 002	125892	475	4 328
6	Romania	20 121	421 015	33 352	241	702
7	Netherlands	17 022	115 340	72 980	40	-
8	Czech Republic	10 610	2 678 732	16 757	92	1 392
9	Sweden	10 120	127 750	27 783	110	414
10	Hungary	9 798	77 969	25 303	121	897
11	Austria	8 773	302 154	47 951	-	-
12	Bulgaria	7 365	60 536	9 119	146	301
13	Denmark	5 756	41 040	13 107	61	-
14	Finland	5 474	104 392	11 851	61	696
15	Croatia	4 290		14 507	32	117
16	Lithuania	2 848	26 954	9 394	103	181
17	Latvia	1 950	18 638	9 137	79	381
18	Estonia	1 314	26 120	4 733	28	102

Source: CTIF, 2019

The data compiled by the Centre for Fire Statistics and published in the World Fire Statistics on fire accidents took place in 40 countries in 2017. It provided basis for the following conclusions[3]:

1. EU countries with the highest number of injuries inflicted by fires on civil populations in 2017 (calculated per 1 million inhabitants) were - Latvia (19.5), Great Britain (13.9), the Czech Republic (13.1), Finland (12.7), Poland (11.3) and Hungary (9.2).

2. EU countries with the highest number of (built) structure fires in 2017 were - France (84 694), Poland (32 388), Austria (19 447), Sweden (10 638), Hungary (9 493), Denmark (7 160), Finland (5 288), and Croatia (3 581).

3. EU countries with the highest number of forest fires were – Croatia (6 981), Poland (3 316), and Sweden (2 784).

4. EU countries with highest number of vehicle fires in 2017 were – France (108 597), Poland (9 408), Sweden (5 364), Bulgaria (2 364), Finland (2 080), the Czech Republic (2 035), and Denmark (1 988).

[3] Not all EU countries are included in the CTI's 2017 Fire Statistics, i.e. Portugal and Greece were missing.

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5. EU countries with the highest numbers of grass and bushfires in 2017 were – France (61 648), Poland (17 035), Bulgaria (14 307), Romania (10 040), Lithuania (2 683), Sweden (2 671) and Austria (2 605).

EU countries with the highest number of rubbish fires in 2017 were – Poland (19 598), Bulgaria (6 894), Romania (4 384), Sweden (2 290), and Lithuania (2 074).

Table 6: Selected EU countries by Number of Structure and Vehicle Fires and Deaths Attributed to These Fires in 2017

No	Country	Number of structure and vehicle fires	Number of deaths
1	France	193 291	239
2	Austria	20 987	-
3	Sweden	16 002	105
4	Hungary	10 265	115
5	Denmark	9 148	58
6	Finland	7 368	58
7	Croatia	4 360	25
8	Romania	4 272	229
9	Bulgaria	2 572	139
10	Lithuania	2 350	98
11	Estonia	1 660	36
12	Latvia	1 613	75

Source: Brushlinsky et al. 2019

It needs to be observed, that the structure and vehicle fires showed to be more lethal in some EU countries as compared to wildfires. Table 6 above presents the number of structure and vehicle fires and fatalities attributed to these disasters in 2017. France, Romania, Hungary and Sweden suffered most from the highest number of fatalities in 2017.

3.4 Floods and Flooding Hazards

In publication "Urban Areas at Risk of River Flooding" (EEA 2, 2020) forecasts that in many parts of Europe, the risk of river and flash flooding is expected to increase substantially except the North-Eastern Europe where the probability of floods is to fall. As consequence of increase in urban population, the placement of many new urban areas and the accumulation of built assets in low-lying locations close to rivers and other large water reservoirs, the exposure to river and /or flash floods has intensified. Figure 32 shows the low-lying urban areas potentially threatened by river flooding in a one-in-a country flood event both during the less distant past (2008-2015), and the more distant projected future (2071-2100). The report reveals that large urban areas in UK, the Netherlands, Belgium, Germany, Austria and Poland are dangerously exposed to the forthcoming flood disasters. Yet the map does not consider the eventual future changes in urban land-take (fragmentation geometry- FG), nor any adaptation measures like building of flood defences and water retention facilities that may lower the future flood risk (Tavares da Costa et al., 2018), which might delimit the type and scope future urban infrastructure damage.

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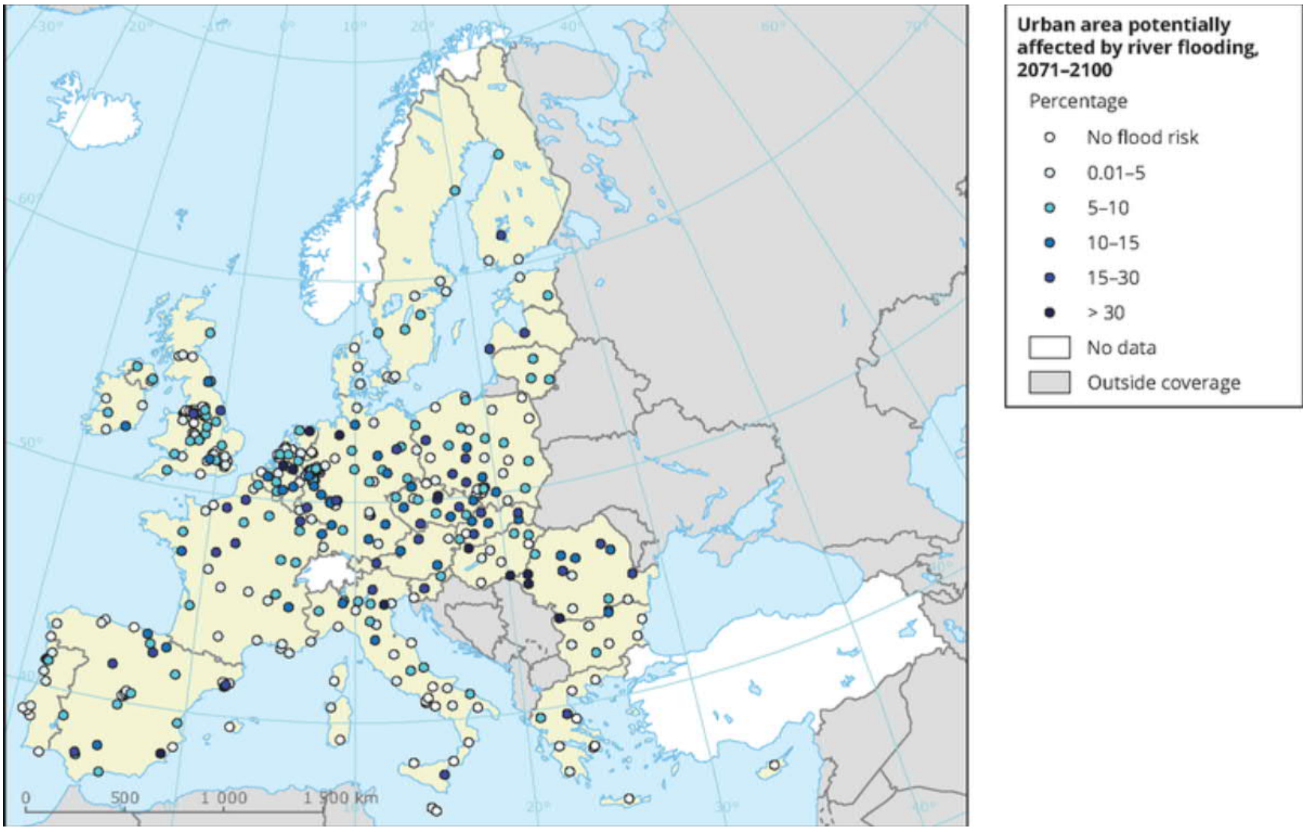

Figure 32: Urban Areas at Risk of River Flooding, Trend 2008-2015
Source: EEA 2, 2020

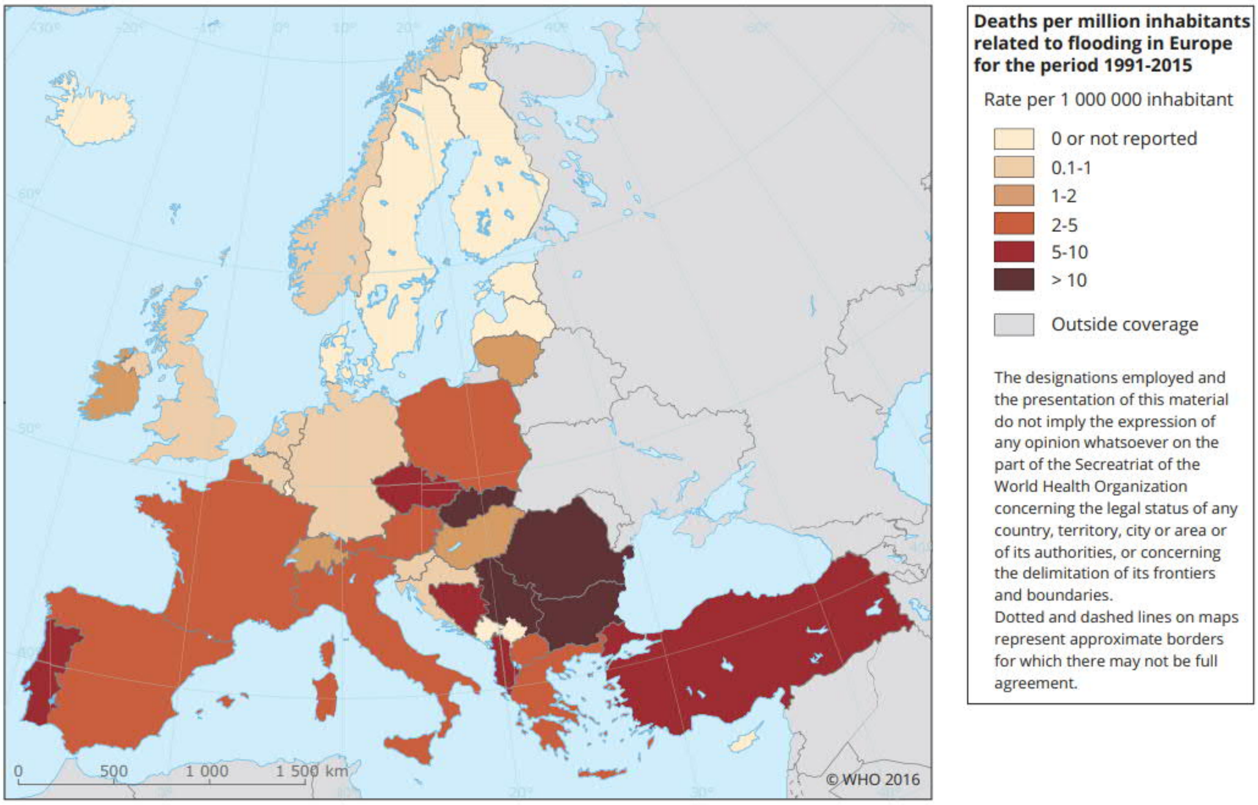

Figure 33: Number of Deaths Related to Flooding per Million Inhabitants (Cumulative over Period 1991-2015, with Respect to 2015 Population)
Source: EEA 3, 2020

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Figure 32 indicates that the highest numbers of flood-attributed mortality during 1991-2015 were recorded in Romania, Bulgaria, Slovakia and Serbia. The second highest number of people whose mortality was associated with riverine and flash floods were in the Czech Republic and Portugal in the EU, and in Albania, Turkey and Bosnia outside EU. At the third place in statistics on flood fatalities were the four Mediterranean basin countries, Spain, France, Italy and Greece.

Further, based on data from the Mediterranean Flood Fatality Database (MEFF DB), 24 deaths were recorded in November 2017 in Western Attica in Greece, 13 deaths in Balearic Islands in October 2018 in Spain and in southern France where 15 people also died during October flood in 2018 (Vinet et al., 2019). This shows that flood-related mortality remains a major concern within the EU, not least in the countries around the Mediterranean basin.

Studies of data repositioned in a 39-year-old European Flood Fatalities Database covering period 1980-2018, indicate a stable trend in flood mortalities influenced by increasing individual fatality numbers in Greece, Italy, and Southern France and decreasing fatality counts in Turkey and Catalonia in Spain. A study by Petrucci et al., (2019) which in addition to southern Spain, France, Italy and Greece also included Portugal, The Czech Republic, Turkey and Israel during 1980-2018 has recorded 2 466 fatalities during the 39-year period for which data were collected and analysed. It revealed that persons killed were mainly men, aged between 30-49 years and majority of deaths happened outdoor, on the roads. Most often people were dragged by water and/or mud when travelling by motor vehicles. Female mortality was higher than the males in the following age cohorts < 15 years (children), 16-29 years (young adults), 65-84 (elderly) and elder than 85 years. Some cases of hazardous behaviours such as fording rivers, were also detected (Petrucci et al., 2019). The primary clinical cause of death was drowning followed by heart attacks; with the latter might being exacerbated by the pre-existing chronic medical condition of cardiovascular disease.

Majority of flood-related mortality cases in the Mediterranean region found place in six national regions: Catalonia (Spain), Balearic Islands (Spain), Languedoc-Roussillon, and Provence-Alpes-Cote d´Azure (Southern France), Calabria (Italy) and Western Attica (Greece). Figure below displays fatality rates, F, by NUTS 3 regions in Spain, France, Italy, Greece and Turkey (Vinet et al., 2019).

3.5 People Affected

In the pursuit of assessing how the scorching disasters affected the EU most vulnerable sub-populations, a paper by The Centre for European Social and Economic Policy (CESEP-ASBL) titled "Social Scoreboard and Persons with Disabilities" was reviewed. (Grammenos, 2019). According to that study, at European level in 2016, 30.1% of persons with disabilities aged 16 and above lived in households which were at risk of poverty and social exclusion compared to 20.9% of persons without disabilities in the same age group. The percentage for all persons aged 16 and over is 23.1 %. At the EU level, the poverty gaps between persons with and without disabilities amounted in 2016 to 9.2%. High poverty gaps were found in Bulgaria, Estonia, Ireland and Latvia (Figure 34). On the contrary, small poverty gaps affecting people with limitations were found in Romania, Greece and Italy. The last two nations were severely affected by fires in 2017, 2018 and 2019.

Figure 34 shows the percent of people who either are at risk of poverty or severely materially deprived or living in households with very low work intensity. Disability was defined by limitation in activities people usually do because of health problems for at least six months. At EU level the gaps are high.

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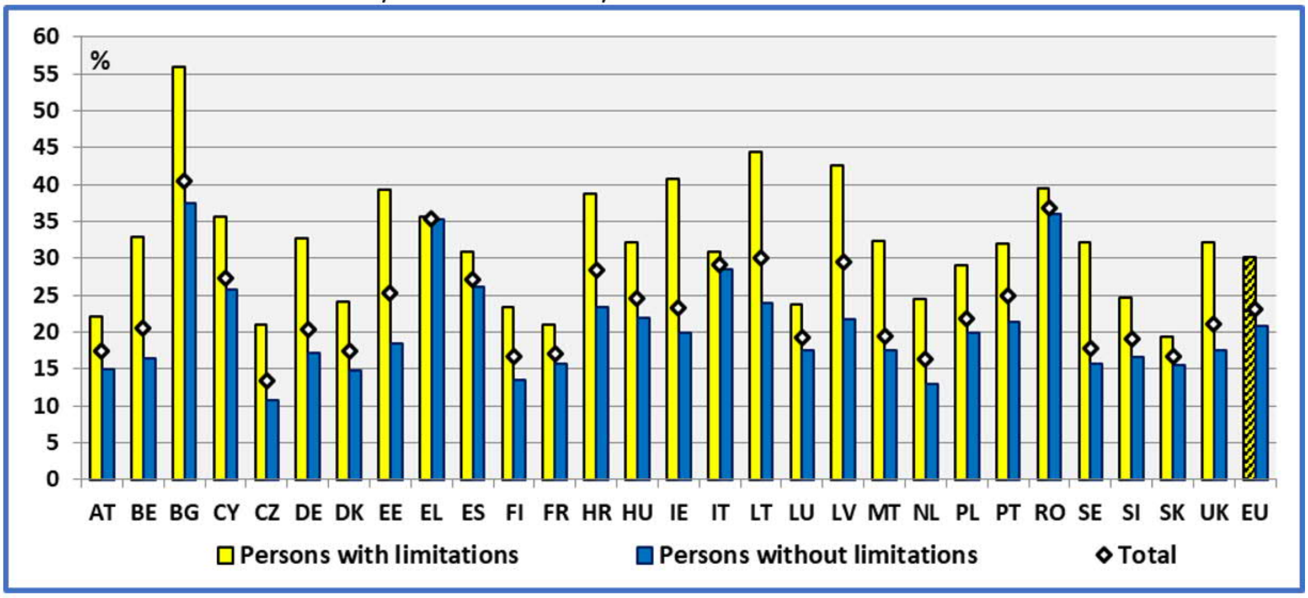

Figure 34: Percent of People Living in Households at-Risk-of-Poverty and Social Exclusion, 2016
Age: 16+
Source: Grammenos, 2019

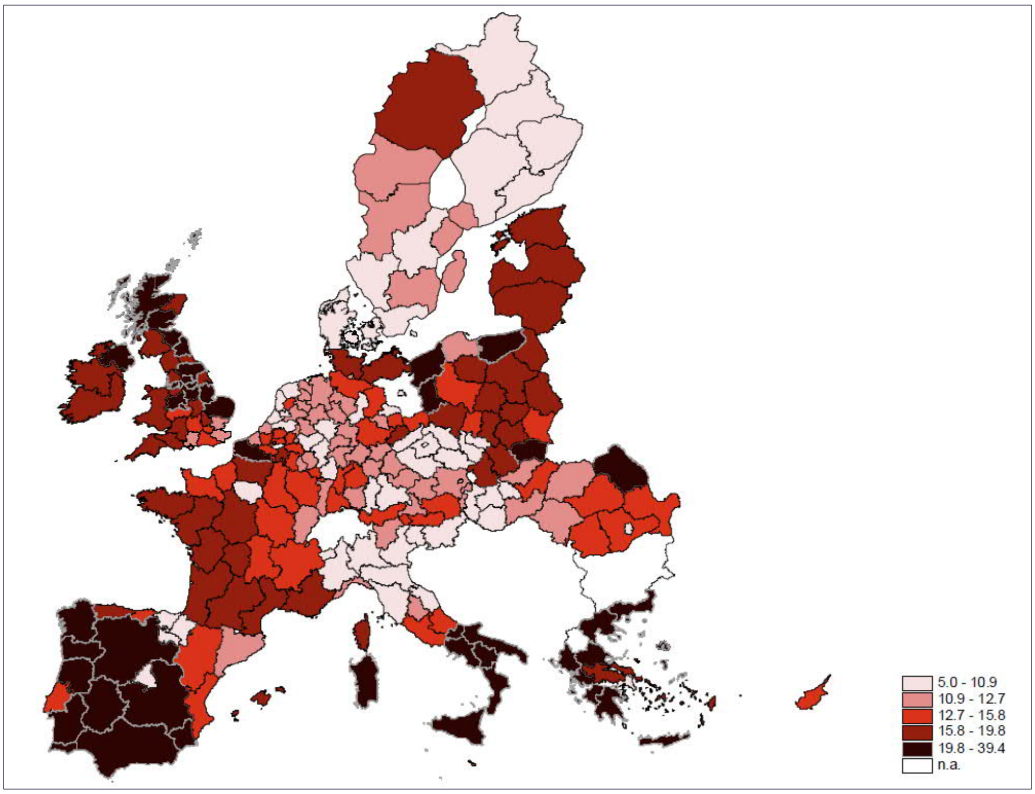

Figure 35: Head Counts Ratio at NUTS2 Regions below County's Poverty Line
Source: Verma et al. 2016

Figure 35 shows percentages of people domiciled in the EU country regions who lived below the national poverty lines in 2016. Comparison of data on fires geospatial distribution with map of poverty concentration in EU regions indicates that the regions with highest share of poor people have also been affected in 2018 by highly destructive fire disasters. Inspection of figure above reveals the concentration of areas with the highest poverty rates could be found in Portugal, Spain, Greece and Southern Italy. The highest estimated poverty rate in the EU using country poverty lines was in Sicily

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(39.4%), and the next highest in Calabria (39.2%) after excluding the “new” EU member states[4]. Next in this line comes Greece (39%). In UK, the proportion of poverty is quite high outside the South-East, which are the regions that have also suffered badly from fire disasters.

Map in Figure 36 presents data on Pan-European fragmentation as defined by Fragmentation Geometry Index (https://www.eea.europa.eu/about-us/countries-and-eionet/intro). The relevance of increases in high concentration of the European landscapes being interrupted by high-level interventional fragmentation consist in investments in overland infrastructure which alter the geomorphic characteristics of the territory covered by decreasing the speed of water absorption into underlying earth layers and increasing the risk of water spillage and area overflows.

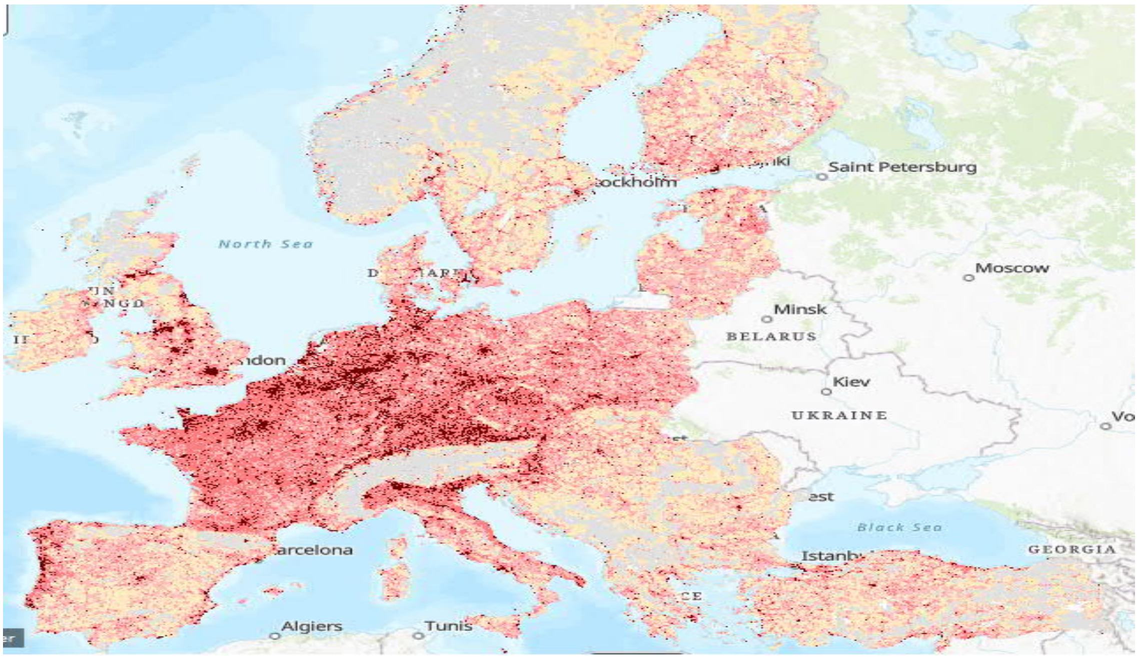

Figure 36: The Fragmentation of European Landscape Interrupted by Fragmentation Geometry (FG), 2016[5]

Source: https://www.eea.europa.eu/about-us/countries-and-eionet/intro

Figure 37 shows the European cities with large senior sub-populations and high-level old-age dependency ratio stratified by the size of sub-populations of elderly inhabitants. Inspection of map mentioned in chapter 3.4 persons killed in floods have been mainly men, aged between 30-49 years and majority of deaths has happened outdoor, often on the roads. Also, young girls < 15 years, 16-29 years old girls and elderly women aged 65 and more are prone to death in floods.

The map also indicates that Germany, France, UK, Spain, Portugal and Italy possess large sub-groups of elderly citizens settled in the southern parts of Europe. These areas are often at low elevations, which increases exposure to risk of riverine and flash floods and sea storm inundation. In addition, some areas of Portugal, Spain and Italy run high risks of wild fires. Thus, when designing

[4] “New Member States” include countries who joined the European Community in 200 and 2007.

[5] FG is defined as presence of surfaces and traffic infrastructure including mediums sized roads. The more FG fragments the landscape, the higher the effective mesh density, hence the higher fragmentation. The higher the fragmentation, the higher the land areas covered by impenetrable structures which obstruct or delay water absorption thus contributing to water retention, overflows, flooding and inundation.

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hazard preparedness for fire perils, it might be advisable to assign special resources to quick evacuation of the elderly and people with disabilities because these might be incapable to evacuate on their own.

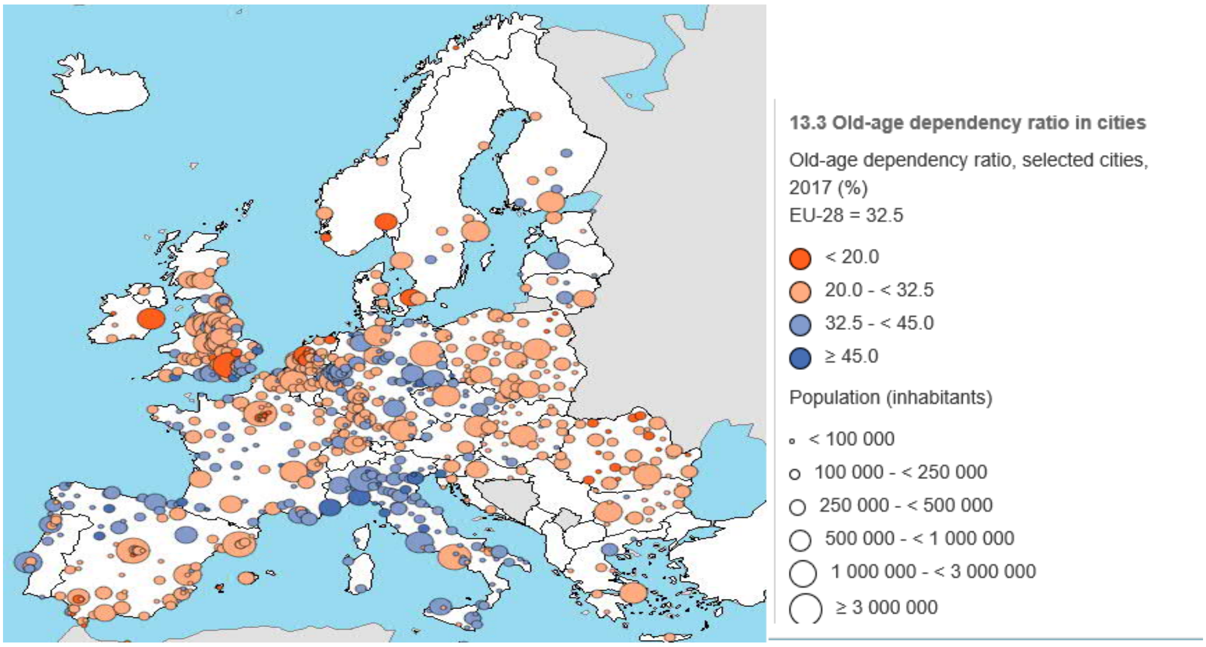

Figure 37: Old-Age Dependency Ratio in Selected Cities, 2017 (%) by Population Numbers
Source: Eurostat, Statistical Atlas, Eurostat Regional Yearbook, 2019 athttp://ec.europa.eu/eurostat/statistical-atlas/gis/viewer/?year=&chapter=13&lcis=BKGNT02016&mids=BKGCNT,BKGNT02016,C13M03&o=1,1,1&ch=GRP,C13&center=50.00754,19.98211,3&

3.6 Migrants and Asylum Seekers

One issue to be mentioned is the situation of migrants and asylum seekers who are not familiar with European weather and climatic conditions nor with local languages. In this context, it is interesting to compare the flood afflicted regions of Southern Europe with travel routes for crossing of Mediterranean Sea by refugees and migrants approaching EU from Asia and Africa. The chart below (Figure 38) shows the number of migrant and refugee arrivals to Spain, Italy, Greece, Malta, Bulgaria and Cyprus in 2018 and the sea-crossings-routes chosen by them to reach mainland destinations. High number of drownings among these groups during the sea-crossing journeys indicate these people took very high risks to escape that made them highly susceptive to death, traumatization, malnourishment and integration challenges.

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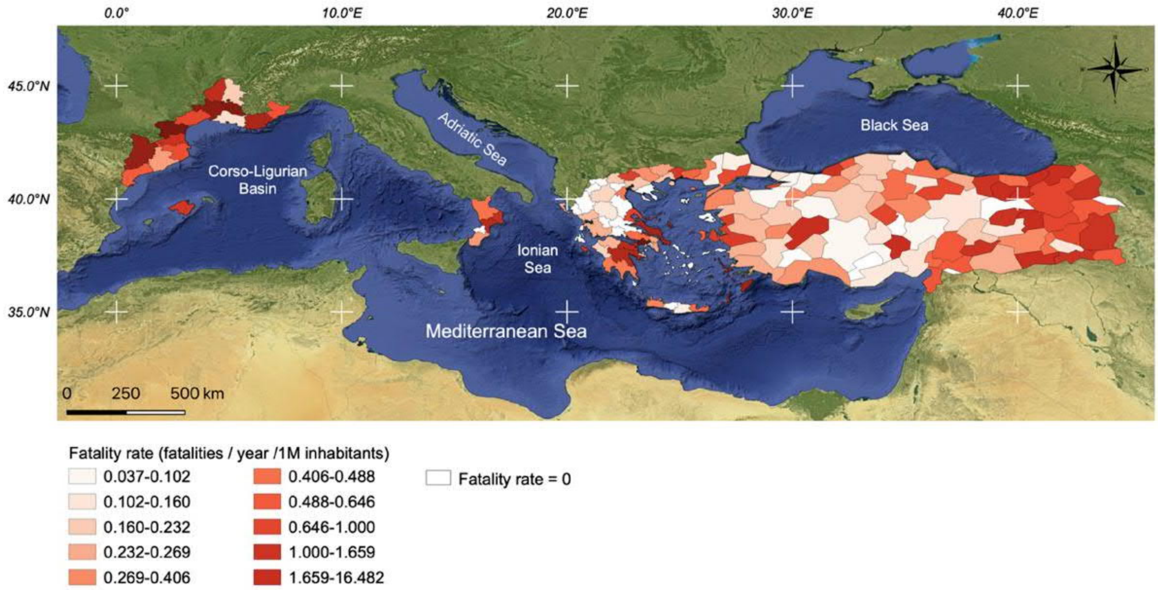

Figure 38: Fatality Rate (F) Attributed to Floods (Pluvial and Fluvial) by NUTS3 Regions in Spain,Italy, France Greece and Turkey
Source: Vinet et al. 2019

Migrants and refugees seek new lives in the EU (see Figure 39). After arrival, they are put into refugee/migrant camps while their applications for resident permits are considered by the host country authorities. Yet, large number of applications are rejected, and entrants are ordered to leave the host country (Atlas of Migration, 2020). Many however do not leave, stay on and oftentimes become homeless. Lacking the geospatial knowledge of settlement locations, language and cultural understandings plus social network and families, they become very susceptible to extreme weather, pluvial and fluvial floods and fire disasters. Comparison of content in Figure 38 and Figure 39 indicates clearly that migrant landing destinations in 2017 and 2018 were located within the flood-affected-regions of Spain, Greece and Italy. Although no valid data could be found for linking flood- and/or fire-inflicted mortality in inland areas with migrant and refugee landings, still information provided by Migration Policy Institute indicates that in 2018 and 2019 many people from Africa (sub-Saharan), Asia and Pacific, Central America and Caribbean, Middle East and North Africa and South America illegally entered EU borders. This allows to posit that these persons could be in much higher risk of life loss than local population because they are not familiar with safety instructions issued by national authorities and might deliberately avoid help from official rescue and relief teams because of the lack of status legality and high probability to be returned to home country. These conditions might have collectively made them highly susceptible not only to flood and fire dangers, but also to extreme cold and other atmospheric stressors.

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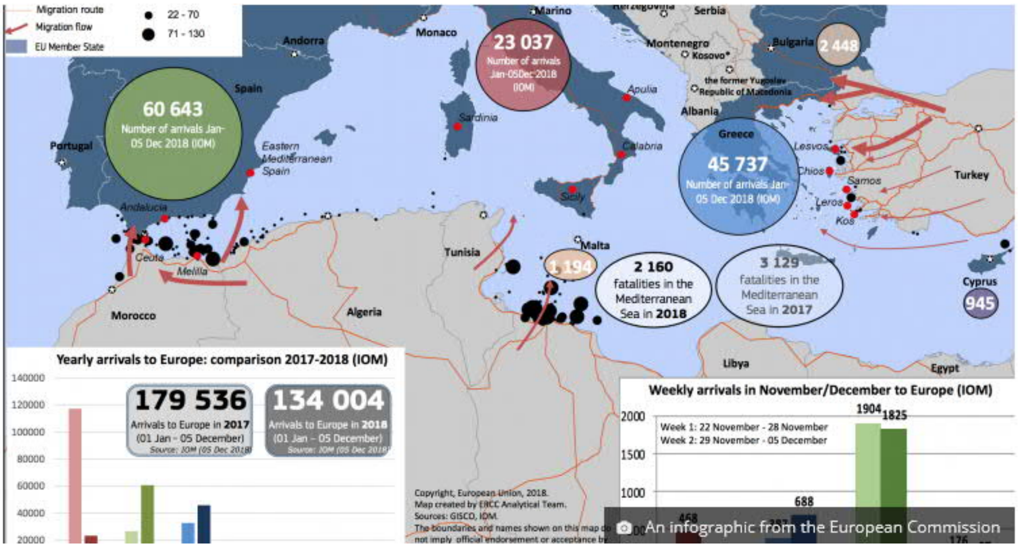

Figure 39: Fact and Figures for Migrant and Refugee Arrivals to the EU in 2018
Source: ERCC and European Commission.

3.7 Conclusions

The study of hazard events over 2006-2016 shows that floods were the calamities which most severely and frequently hit Europe. Floods were most common in Eastern and Southern Europe. In addition, meteorological hazards, including heat waves and cold spells happened quite frequently in Southern Europe during this study period. Geophysical hazards, i.e. earthquakes also affected the southern belt countries. Climatological hazards such as structural and wild fires and impacts of high atmospheric variability affected the entire Europe because of climate change. Due to these natural hazards about 300 people died in 2016 in earthquake in Italy. However, during the study period in Western Europe over 700 people lost they lives due to heat waves and cold periods and almost 6 000 people died in Eastern Europe including parts of Russian Federation.

Disasters affecting most people were wild fires and floods especially in Southern and Eastern Europe, earthquakes in Southern Europe and heat waves in other parts of Europe except Northern area. In Northern Europe only floods are registered to affect about 40 000 people.

When combining the economic damages due to these disasters, the earthquakes have been most expensive to the society. The second harmful damages have been floods, and after that heat waves and cold periods.

The CRED report shows that large scale disasters are not frequent in Europe apart from destructive earthquakes. The whole Europe, except the Northern area, suffer especially from meteorological events, such as cold and heat waves. These events cause also most of the human deaths. The floods are most recurrent events in the whole Europe, and they affect every year thousands of people. Flood also inflict high costs. The geophysical events are common in Southern Europe, where they cause most of the deaths and costs of disasters. The climatological disasters, such as wildfires, are quite common in Southern Europe, and they may kill tens of people. However, the statistical values of lives lost have not been calculated.

According to the EEA report on economic losses caused by natural hazards during 1980-2017, the average annual economic loss (inflation-corrected) was around € 7.4 billion per year in the 1980, € 13.4 billion in the 1990s, and € 14.0 billion per year in the 2000s (2000-2009). In the last period

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2010-2017 the average annual economic loss amounted to around € 13.0 billion (EEA 2020). During this time space, the heat waves and cold periods have contributed to 68 % of all deaths, while the floods and storms have inflicted 62 % of the total losses and 90 % of the insured losses.

The fire hazards are more common in Southern Europe and Balkan area due to climatological reasons. It also seems that for a period 1945-2016 there are specific areas where fire casualties were more probable than in the others. It is important to notice that wildfires hit especially in Southern Europe, which, according to the Eurostat, seems to be more sensitive to the risk of poverty and social exclusion than Europe in general. In addition, it seems that the wild fires especially in late winter and early spring are more common than earlier. The civilians who die in wild fires seem to be the elderly, children or people who have difficulties to escape the fire blaze. Interesting is that young women under 20 years are more often victims of the fires than the young men of same age.

Floods may hit whatever part of Europe but until today, their effects on humans and properties have been smaller in Northern Europe. Most of the deaths per million inhabitants take place around the River Donau, from Balkan area to Black Sea, but also the area of Slovakia and Checks Republic have been highly affected. The studies disclose that persons killed in floods were mainly men, aged between 30-49 years and majority of deaths happened outdoor, on the roads. Most often people were drowned in water and/or mud when travelling by motor vehicles. Female mortality was more numerous than males in the following age cohorts < 15 years (children), 16-29 years (young adults), 65-84 (elderly) and older than 85 years.

Some areas in Southern Europe where the natural disasters hit suffer also from the highest rate of poverty affecting their 19,8 -39,4 % of population. Especially bush fires and earthquakes hit these areas. In addition, heat waves and cold periods are quite common there.

The fragmentation of built areas shows investments in the overland infrastructure. Newly built areas may alter the geomorphic characteristics of the territory. The land covers, such as buildings and road pavement prevent rainwater infiltration into the soil. That’s why there is a need for effective storm water drainage and/or retention systems. The fragmentation is high in Central part of Europe, north side of the Alps, on the discharge areas of big rivers, i.e. Seine and Rheine.

In Some European areas over 45 % of local population is composed of 65 years old people. Because these age groups might be in higher risk of fire and flood dangers, it is important to devise effective preparedness improving solutions for these people.

One group, which is severely vulnerable towards fires and floods are refugees and migrants who are not familiar with the Europe’s climate conditions, languages and self-protection instructions issued by local authorities. They might also avoid public rescuers because of lack of residence permit or other documentations.

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4. LINKS BETWEEN THE ATMOSPHERIC VARIABILITY AND MORTALITY OF VULNERABLE PEOPLE

4.1 Human Vulnerability and Environmental Risks

To broader our understanding of impacts that natural hazards invoked on vulnerable people's lives it is important to explore the reciprocal relationship between human populations and natural environments. The environment itself might be understood as "a combination and interaction of natural and human systems which both produce and are affected by global change" (Klein, 2006). Within this context, the increasing vulnerability of human habitats and livelihoods to climatic hazards can be considered as socially produced (Hemingway and Priestley, 2015). The idea that vulnerability is socially affected is not new, and evident in analyses of human geography and political economy (Blaikie, Cannon, Davis and Wisner, 1994; Cutter, Boruff and Shirley, 2003; Dow, 1992; Liverman, 1990; Timmermann, 1981) Such approaches have motivated research into interactions between social and/or individual life factors and climate-variability and their collective impacts on risks to human lives (Füssel and Klein, 2002). To this end, the International Disaster Reduction Strategy defines vulnerability as "The conditions determined by physical, social, economic, and environmental factors or processes which increase the susceptibility of a community or an individual to the impacts of hazards" (https://digitallibrary.un.org/record/455415).The same definition is incorporated in the Hyogo and Sendai Frameworks on reduction of social vulnerability to climate impacts. From this perspective, social vulnerability to natural hazards might be dependent on techno-social organisation of human systems as well as the "every pattern of social interaction with surrounding ecosystems" (Yamin et al., 2005).

If social vulnerability to natural hazard can be moulded or even amplified by socio-economic factors, then socially disadvantaged groups are likely to be disproportionately more affected (Hemingway and Priestley, 2015). Recent Climate Change Agreements (Hyogo, Kyoto and Paris) highlight the specific vulnerability of disadvantaged populations and suggest a link between economic welfare, civil protection and enhanced levels of vulnerability arising from climate change. Yet the concept of human vulnerability is a complex one and cannot be considered as simply a proxy for poverty removal and social inclusion. It is also a function of coping, techno-social resilience, adaptability and intra-and-inter communal cohesion. Yamin et al. (2005) argues that communities are not homogenous. Sharing climate impacts or threats does not imply that all members of the community are affected in the same way. Human communities are highly differentiated in terms of access to resources and factors such as age, gender, class and ethnicity. These differences will affect their members' vulnerability and capacity for hazard resilience.

Incorporating these perspectives into vulnerability assessment, the connections between social welfare, social marginalisation, demographics, weather patterns and severity of hazard impacts on specific human cohorts are explored below.

4.2 Links between Temperature and Population Mortality

Relationship between non-catastrophic changes in ambient conditions imposed by climate change and human mortality is hard to pinpoint causally due to complexity of human reactions to atmospheric

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environment and the potential confounding effects of the other factors (e.g., other atmospheric characteristics, effectiveness of public hazard preparedness, socio-demographic conditions of people exposed to hazard impacts and individual resilience level). Still, research in epidemiology, social marginalization and climatology show that heat and cold waves are associated with lower well-being among general population and increases in mortality and morbidity among some social groups whose death toll exceeds the death numbers among general population.

Mortality-temperature association is often schematically described as U-shaped (or V- or J-shaped) exposure-response curve with a trough at the so-called minimum mortality temperature (MMT) and an increase in mortality towards hot and cold tails of temperature distribution (Armstrong, 2006). These methods have been used to document that more frequent heat waves within the different climatic zones in Europe were related to thousands of premature deaths in Europe since 2000 (Gasparrini et al., 2015).

The largest effect of heat waves has been observed among the elderly (75+), but in some places, also among people of all-ages, including younger adults. Although elderly people might be more vulnerable to the effect of heat or cold, many other population subsegments also face a heightened risk of mortality attributed to temperature stressors. People with disabilities[6] who often suffer from lower socio-economic status and attitudinal negativity or simply those with poor health living in poverty or other forms of relative deprivation, the permanently homeless, rough sleepers, substance abusers, and migrant workers, in addition to homeless families (especially with young children and elderly members), are more prone to psychological stress and physical ailments induced by severe ambient conditions (Caritas International, 2011; Ramin and Svoboda, 2007, Kumari-Cambell, 2008)[7].

Also, people exposed to long hours in sun, hot, cold and humid weather (such as manual labourers), or migrants or refugees who move between different climatic zones and who might be deprived of access to shelters with cooling/heating facilities and/or other needy protection measures, are also exposed to higher risk of life loss compared to better shielded population segments (Cahn and Guild, 2010; European Asylum Support Office, 2016). Research indicates that mortality and morbidity among people who rapidly move between hot and cold climatic zones with different range of seasonal temperatures, winds strengths, precipitation and radiation intensity are more exposed to death hazard. Combinations of these ambient stressors strongly affect the human energy balance and the individual biothermal resilience whose impact might induce traumatic condition and overpower the influence of air temperature alone (Jendritzki, 2009; Ruuhela et al.,2017). Also, Schell et al. (2020) work has confirmed that the negatives of atmospheric stressors are often reinforced of racial and/or ethnic backgrounds and disparities in wealth.

Therefore, the minimum mortality temperature (MMT) degrees vary across the regional climatic and atmospheric conditions. Lower MMT levels prevail in cooler lands while higher in warmer regions. The differences in MMT could indicate the differences in levels of acclimatization of population exposed

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[6] People with disabilities are defined by the Centre for European Social and Economic Policy as persons with limitations reducing their activities because of health problems lasting for at least six months, Greammenos, S (2019) Social Scoreboard and Persons with Disabilities, Working Paper, March,2019

[7] The definition of homeless people commonly used in *health* research includes individuals and families who sleep in shelters or other intermittent lodgings as well as “absolute” “core” or “sustained“ homeless, such as individuals and families who sleep outdoor or at places not intended for human habitation with low external protection (Hvang, Tolomiczenko, Kouyoumodijian and Garner (2005) “Interventions to Improve the Health of the Homeless: A Systematic Review” American Journal of Preventive Medicine, 29 (4) .311e1-311-9 and European Observatory on Homelessness , 2017.

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to given climatic conditions (Guo et al., 2014). Guo at al., (2014) established, based on data from 12 countries in different climatic zones, that MMT is found at approximately the 75th percentile of the temperature distribution, varying between the 66th and the 88th percentile. However, Tobias et al. (2017) detected a much wider range of the MMT among cities in Spain. Some studies in Finland indicated that MMT temperature ranges between 12-17 ºC while in Mediterranean climatic zone, the lowest mortality was observed at 22-25 ºC (Keatinge et al.,2000; Näyhä, 2007; Tobias et al, 2017). As observed, mortality risk induced by temperature and/or other atmospheric conditions varies with biothermal resilience of the population. However, the differences in population fragility and exposure to mortality-related atmospheric hazards depend also on socio-economic, demographic and non-climatic factors. Hondula et al., (2015); (Shi & Stevens,2010) have found that urban environments with high percentage of children, elderly, disabled individuals and residents with minority background living on low income and with low educational attainments are highly exposed to life-threatening atmospheric dangers, although the key explanatory variables varied from one city to another.

Outside their biothermal temperature comfort, people could be highly fragile to hot-or-cold-ambient impacts, thus elevating the relative risk (RR) of life loss (Lucas et al., 2014). The multi-country study by Lucas et al. (2014) has estimated the overall cumulative exposure-response curves (figure below) for mortality in four European cities with the corresponding minimum mortality temperatures and cut-offs used to define mortality-temperature thresholds.

Risk increases slowly and linearly for cold temperature below the MMT, although in London and Madrid it showed a higher increase in extreme cold than in Stockholm and Rome in. Risk generally escalated quickly and non-linearly at high temperatures. Death attributable to extreme heat is roughly as frequent as death attributable to moderate heat, while death attributable to extreme cold are negligible compared to death caused by moderate cold in cities analysed (Baccini et el. 2008).

Exposure-response associations between high temperature and mortality in four European cities together with related temperatures distribution shown in Figure 40 are adopted from the European Environmental Agency elaboration on temperature-induced death vulnerability in four large European cities (EEA, 2016). The shaded grey area delineates the 95 % of empirical confidence interval (CI) for death occurrence. Solid grey vertical lines delineate the 2.5th and the 97.5th temperature percentile.

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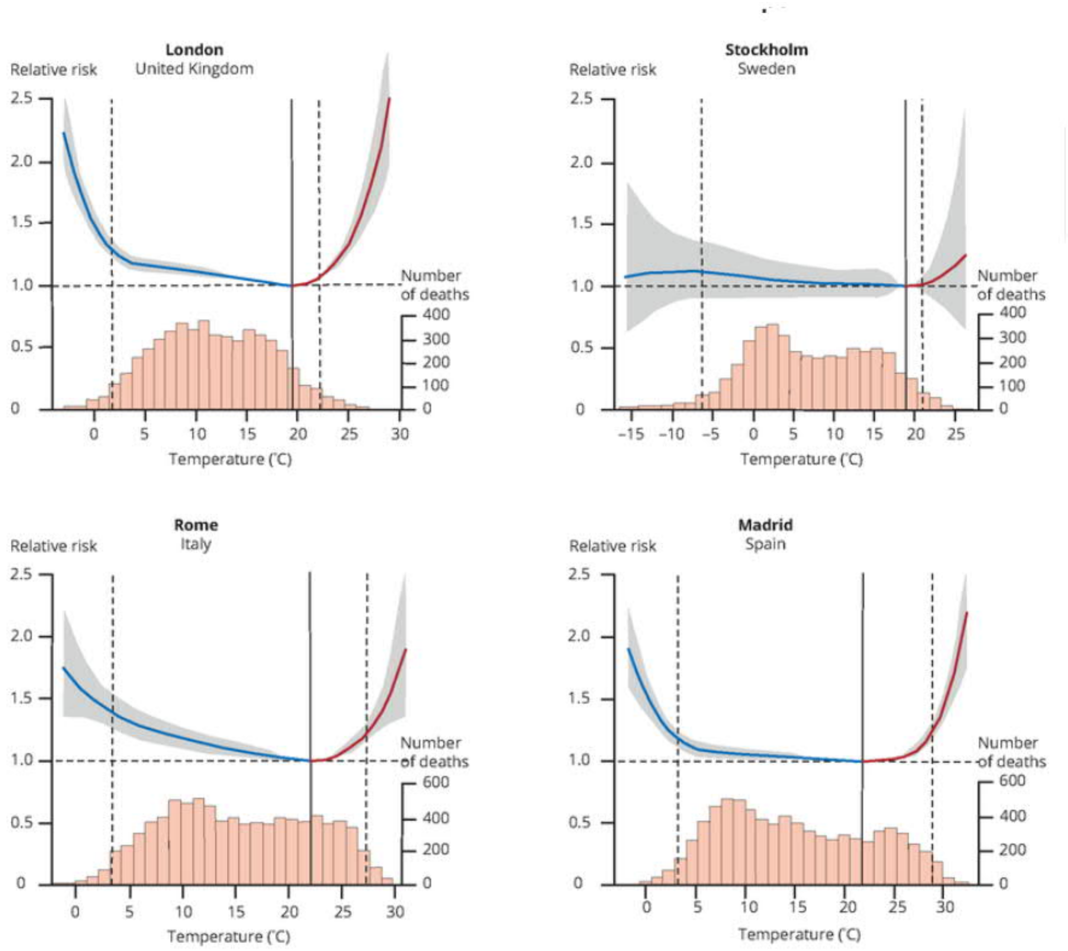

Figure 40: Association between Temperature and Mortality in Four European Cities (2016)
Source: European Environmental Agency, 2016

Other studies (Josseran et al.,2011; Wolf et al., 2015) have estimated that about 1.6 - 2.0% of total mortality in the warm season could be attributed to heat. These results differ from research on heat and cold-related mortality in 18 French cities which revealed that between 2000 - 2010, 3.9 % of the total deaths was attributed to cold weather while 1.2 % to hot temperatures. That indicated that cold represented a bigger challenge to public health in France because it generates higher life risk even at moderately low temperatures. The study has concluded that French population better adapted to warm temperatures, albeit up to certain threshold, which, when slightly surpassed became an acute public health emergency problem (Pascal et al., 2018). However, authors admit, relationship between temperature-mortality can vary broadly between different regional, and administrative settings because it is also affected by the techno-social standards of given location, i.e., the availability of heating at the dwellings and access to green areas which function as natural coolers and/or to mechanically cooled facilities when temperature exceeds caution level. In addition, the population's economic welfare and the quality of health-sector service do moderate the negative impacts of temperatures. These parameters might also determine the effectiveness of prevention measures in the place, i.e., how effectively the medical help and other social relief provisions protect the population exposed against health and life-threatening hazards. The quality of public health is important to all population sub-groups, but foremost to highly fragile collectives because it is virtually certain that the length, frequency and intensity of heat waves will increase in the future as the climate change accelerates (https://climate-adapt.eea.europa.eu/metadata/publications/peseta-ii-health-impacts-and-related-costs-of-climate-change-in-europe)

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An indication of what may become more frequent in the future, the Figure 41 reviews the extreme summer temperatures registered in 2019 in countries located in the Northern part of European continent such as The Netherlands, Belgium and the UK which until recently seldom experienced heat emergencies.

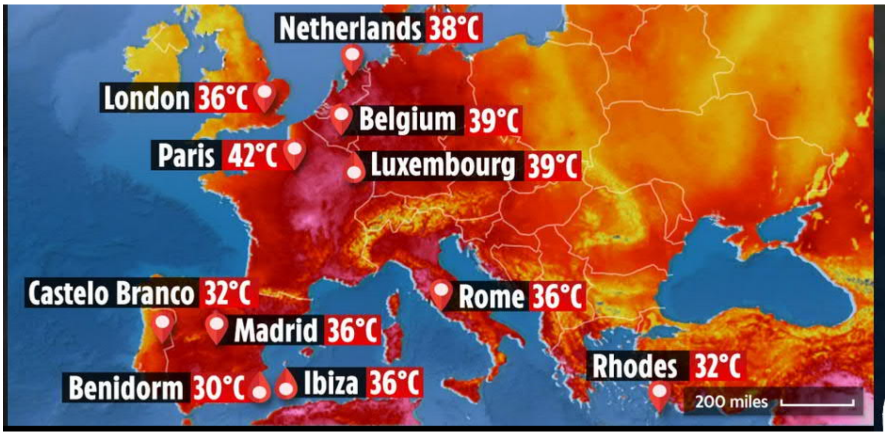

Figure 41: European Heat Waves 2019. 10. 28.
Source: The SUN Newspaper, July 26th, 22:40 hrs.

Several studies confirm that the homeless people are particularly vulnerable to variability in meteorological conditions, such as hot or cold weather and heat waves because the risk of mortality and morbidity arising from these factors correlate closely with the characteristics of homeless individuals (Ramin and Svoboda, 2009). Pre-existing psychiatric illness has been shown to triple the risk of death from extreme heat. Other risk factors for death during heat waves include cardiovascular disease, pulmonary disease, advanced age, living alone, substance abuse and cognitive impairments. In addition, homeless are often forced to live in hazard-prone areas and often lack appropriate resources to protect themselves against potentially harmful events (Winchester, 1992; Wisner, 1993). These characteristics make them extremely fragile and susceptible to hazard strains. Furthermore, majority of homeless in the EU live in urban and sub-urban areas where they are at increased risk from heat waves due to “heat island effect” (Bouchama et al., 2007). The effect occurs because the built structures such as concrete, asphalt and meta elements preferentially absorb heat that is then re-radiated thereby increasing the heat in urban areas by at least 5-11 ºC compared to rural regions.

Also, several climate change studies do project that increasingly higher numbers of urban population will be exposed to heat-related atmospheric adversities including the homeless persons because the numbers of city inhabitants in some metropolitan areas are expected to increase substantially toward 2050 (Figure 42) (Confalonieri et al., 2007).

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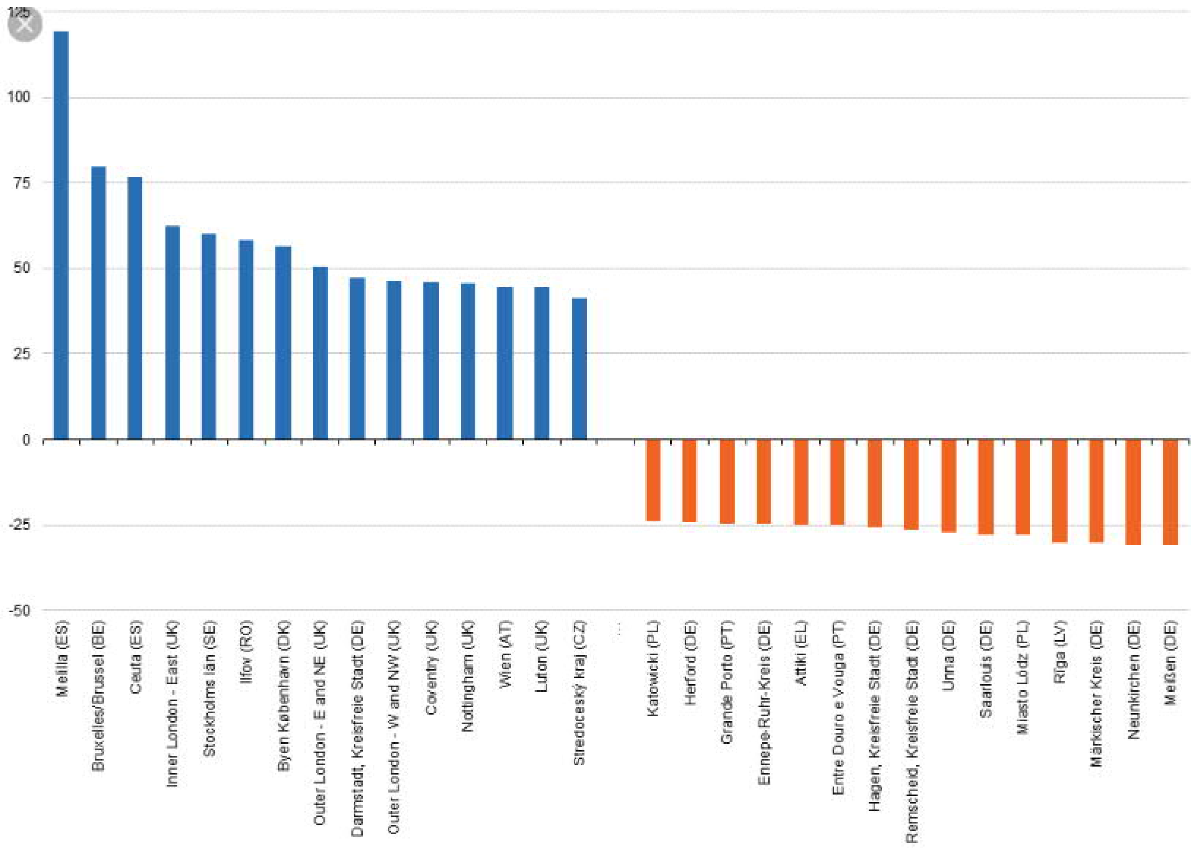

Figure 42: Projected Rates of Change of Number of Inhabitants of 15 Predominantly Urban Regions in the EU-28 during the Period 2015-2050
Source: Eurostat, 2016

Because it is likely that the frequency and duration of heat extremes such as the numbers of monthly heat records will increase, the consequence will be a marked increase in inhabitants' thermal discomfort levels in many EU cities. This might lead to higher numbers of excess heat-related deaths, unless effective adaptation policy measures are deployed. People in highly urbanized areas are projected to be at higher risk of heat stressors as compared to those living in rural surroundings because of lesser greenery in city landscape capable to absorb the heat and counteract higher heat accumulation in build structures producing urban heat islands (https://climate-adapt.eea.europa.eu/metadata/publications/peseta-ii-health-impacts-and-related-costs-of-climate-change-in-europe).

A study of changes in heat/cold ambient temperature impacts on human wellbeing and death risk shows a doubling or tripling in frequency of "great discomfort" in some EU southern cities like Athens and Palma among general publics. Also, observational evidence (1959-2018) and short term-forecast until 2025 of ambient temperature changes in the northernmost European cities (Helsinki-Vantaa and Oulu) show that the heat-induced discomfort is becoming increasingly more frequent because high temperature spells have nearly quadrupled during the last decade (Founda et al., 2019). The graphics below (Figure 43) illustrate changes in hot/cold days per decade in Athens (a) Sophia (c), Palma (e), Paris (g) Rotterdam (i), and Helsinki-Vantaa (k).

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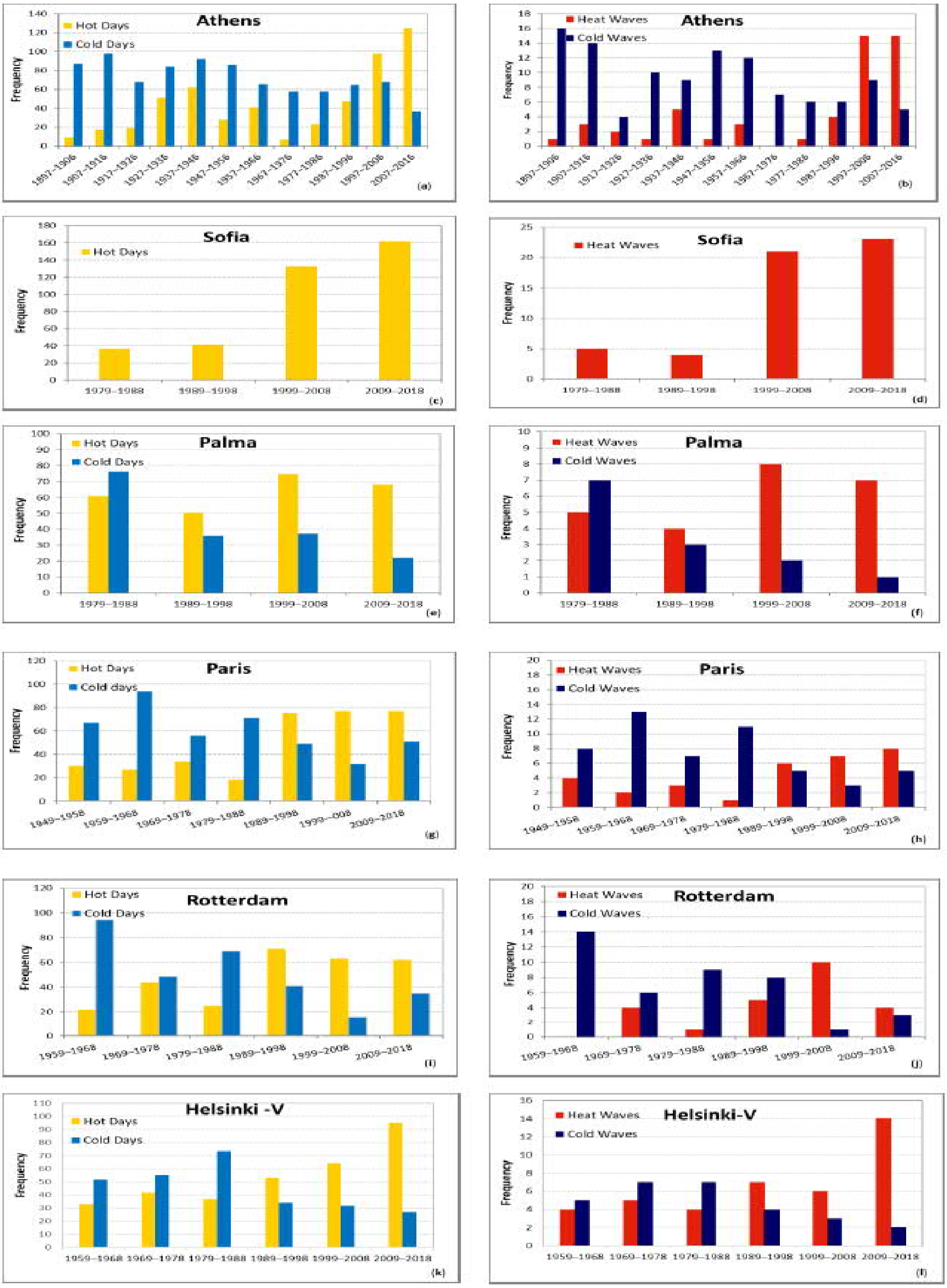

Figure 43: Frequency of (total number of hot/cold days per decade in Athens,Palma,Paris, Rotterdam, Helsinki (Vantaa)
Source: Founda et al., 2019

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It is interesting to observe that in all studied the city warming trends are associated with simultaneous decreasing trends in occurrence of cold extremes, namely cold days, even in Helsinki-Vantaa where the decrease become more abrupt since 1980's. The readings of ambient temperature at Helsinki-Vantaa has shown the frequency of hot days has been increasingly progressive since 1980's and that a very prominent increase in occurrence of hot days is observed during the last decade (2008-2018). As result of these temperature changes, the frequency of cold-induced discomfort conditions for population exposed dropped by more than 20% in Helsinki-Vantaa and Oulu during the last decade as compared to decade 1976-1985 (Founda et al., 2019). The frequency of cold-related discomfort has also lessened in Rotterdam and Paris during the last decade as compared to the 1970's, while in Athens and Palma, these changes were negligible. On the other hand, however, as the levels and the duration of heat waves have increased in the cities reviewed, so did also the risks of thermal discomfort for the focal population. Because the impacts of heat spells enhance the health and life threats to all population segments, below we present the ranks in heat discomfort conditions for different locations as expressed by heat index (HI) levels (Figure 44).

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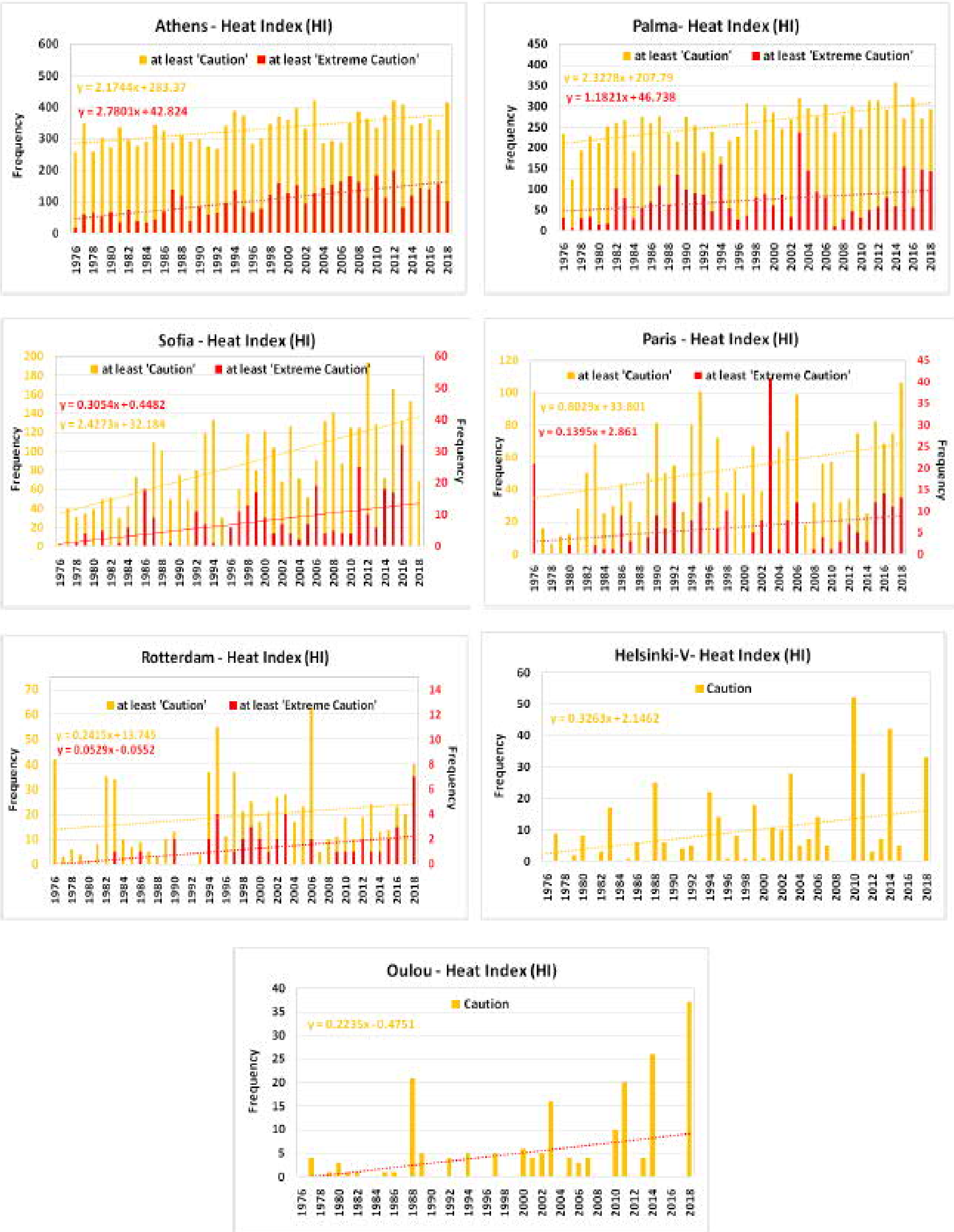

Figure 44: Frequencies (Number of Cases from the Three-hour Resolution Observations) of at Least "Caution" (HI >270C) and at Least "Extreme Caution" (H I> 32 0C) Condition Based on the Heat Index (HI) Classification at European Cities over the Period 1979-2018

Source: Founda et al., 2019

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Based on the HI classification, all cities were found to experience statistically significant ($p< 0.05$) upward trend in frequency of at least “caution” and at least “extreme caution” condition over the years 2010-2018, except Rotterdam, where the occurrence of warm temperatures justifying “caution” and at least “extreme caution” conditions were significant at $p < 0.10$ (Founda et al., 2019). As expected, noticeably higher frequencies are observed in cities with hotter background climate in summers such as Athens, Palma and Sofia and across other locations in Greece, Spain and Bulgaria. In 2015 heat waves in France caused more than 3 000 deaths alone. Even cities in the northernmost latitudes such as Helsinki-Vantaa and Oulu, the recommendation of “caution” because of high temperature became increasingly more frequent during the last decade. Such conditions were almost never observed in the 1970’s, while the “extreme caution” condition did not occur at all.

Since the latter finding might have quite large bearings on vulnerable social groups in Finland, below we explore in-depth the temperature-mortality relationship for this country. For this purpose, two studies are reviewed. The first is the Simo Näyhä’s (2007) work which established causal link between the variability in ambient temperatures and mortality rates in Finland. Using observational data, the study has shown that between 2000 and 2005 the fewest deaths (126 per day) occurred at a mean daily temperature of 12 ºC, and that the deaths increased to 138 per day (by 10%) on the warmest days (+24 ºC), and to 151 per day (20%) on the coldest days (-31 ºC). An estimated 160 deaths per day (0.3% of all deaths) were attributed to higher than optimal temperatures and 2 400 deaths per year (5%) were ascribed to low temperatures. In individual years, the fraction of deaths attributable to heat varied from 0 to 0.5% with little consistency across the summer temperatures. While the relative risk of an individual dying from heat increased consistently with rising temperatures, most heat-related deaths occurred at temperatures less than +20 ºC. During the warm spell in summer 2000, deaths increased by an estimated 360 cases (0.7% of annual deaths) but decreased to 250 (0.5%) once the Midsummer Festival was excluded. Näyhä concluded that as the high temperature spells might become more frequent and more haphazard in future, heat might become a severe threat to public health in Finland, which was not the case until the last decade. Figure 45 shows excess mortality rates related to low and high temperature levels in Finland.

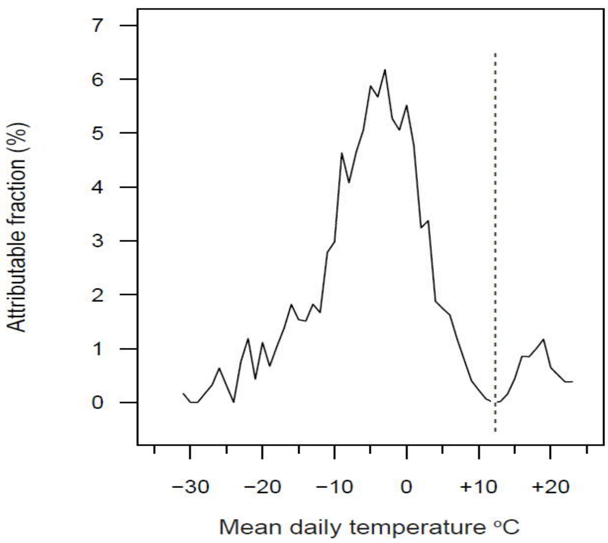

Figure 45: Fraction of Excess Mortality, 2000-2005, Attributable to Temperature Changes Relative to Temperature with the Lowest Mortality. The Temperature of Lowest Mortality (12 0C) is Shown by Vertical Line
Source: Näyhä, S., 2007

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Another study, performed by Ruuhela, Hyvärinen and Jylhä (2018) is quite important because it has explored the numbers of deaths registered across 21 hospital districts in Finland during 2000– 2014 and assessed the regional differences in temperature-mortality relationships at NUTS 5 level. The work by Ruuhela et al. (2018) has thus elongated the study period covered by the Näyhä's research. Also, the methodology was much more sophisticated. The daily numbers of all-cause all-aged deaths were studied in each hospital district by using daily mean temperatures spatially averaged across each hospital district to assess exposure to heat stress and cold stress. The relationships were modelled using distributed lag non-linear model (DLNM). The study incorporated findings from clinical observations indicating that the effects of hot temperature on mortality appear on the same day and usually last few days, while the effects of cold stressors appear after a couple of days and might last about 10 days or even week (Anderson et al., 2009). Taking heed of the above, the authors adopted a 25-day-lag on cold-induced mortality. In a simple model version, no delayed impacts of heat and cold on mortality were considered, whereas a more complex version included delayed impacts to 25 days. Subsequently, a meta-analysis with selected climatic and sociodemographic covariates was conducted to study the differences in the temperature-death relationships between the hospital districts. A pooled mortality-temperature relationship was produced to unearth the average relationship in Finland. The simple DLNM model version gave U-shaped dependencies between mortality and temperatures without exception. The outputs of the model version with a 25-day- lag were also U-shaped almost in all hospital districts. After the meta-analysis was performed, it has shown that the differences in the temperature-mortality relationships between hospital districts were not statistically significant on the absolute temperature scale, meaning that the pooled mortality-relationship can be applied to the whole country. However, on the relative temperature scale heterogeneity was found and the meta-regression suggested that morbidity index in combination with population demographics in the hospital district might explain some of this heterogeneity. The pooled estimate for the relative risk (RR) of mortality at daily mean temperature of 24 ºC was 1.16 (95% CI 1.12-1.20) with reference at 14 ºC which is the minimum mortality temperature (MMT) of the pooled relationship. On the cold side, the RR at daily mean temperature – 20 ºC was 1.14 (95% CI 1.12-1.16). On a relative scale, of daily mean temperature, the MMT was at the 79th percentile. Excerpts from the various hospital districts studied with annual temperature distribution over 1981-2010 and mortality rates in 2014 are shown below in Figure 46.

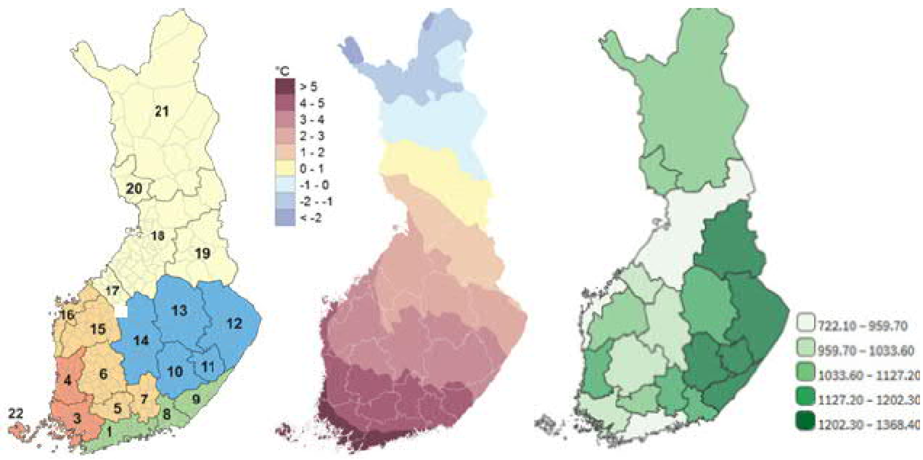

Figure 46: Hospital Districts (Left 2011) Annual Mean Temperature in Finland during 1981-2010 (Middle) and Mortality Rates (1/100,000) by Hospital District in 2014 (Right)
Source: Ruuhela et al., 2018

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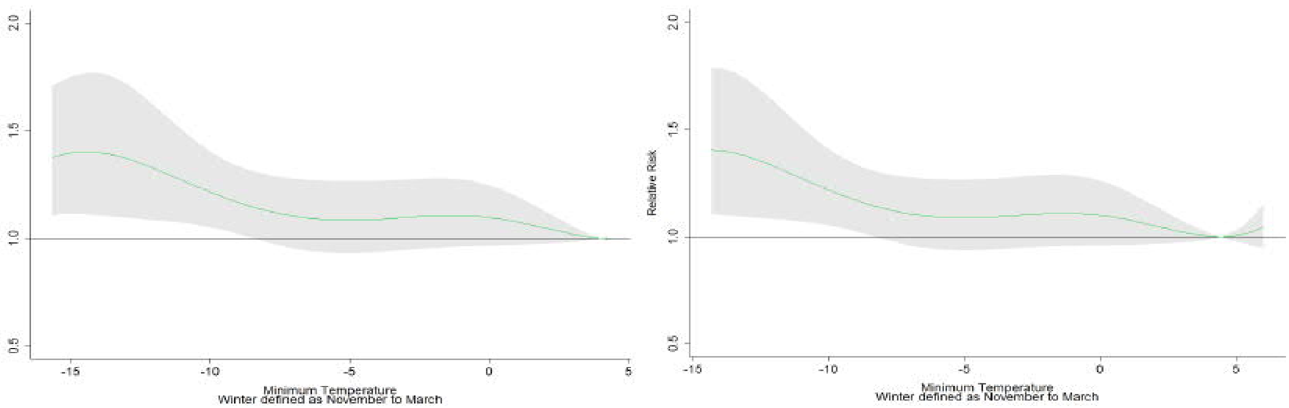
Further, mortality-related to cold temperatures in two capitals of the Baltic countries (Tallinn and Riga) were analysed by Åström et al., (2019) to test the association between cold ambient conditions and all-cause mortality as well as the cause-specific mortality in these two Northern European cities. The study collected daily information on deaths from the state death registries and data on minimum temperatures from November to March over the period 1997-2015 in Tallinn and 2009-2015 in Riga (Figure 47). In total, there were 36 646 deaths in Tallinn and 27 495 deaths in Riga during the study period. The relationship between the daily minimum temperature and mortality was assessed using the Poisson regression, combined with distributed lag non-linear model (DLNM) with mortality lag time up to 21 days. The results showed significantly higher all-cause mortality occurring during periods with cold temperature both in Tallinn (Relative Risk (RR) = 1.28, 95% Confidence interval (CI) 1.01-1.62) and Riga (RR = 1.41, 95% CI: 1.11-1.79). The minimum mortality temperature (MMT) was similar in Tallinn and in Riga at 4.0 ºC and 4.4 ºC, respectively. The MMT was found at the 94.2 and 89.6 percentiles of the cold season temperature distribution in Tallinn and Riga, respectively. Results are presented for the cumulative relative risk (RR) over lags of 0 to 21 days, at the 5th percentile of the city-specific temperature distribution, using the city-specific MMT as a reference. The study has shown that cold temperatures significantly increased all-cause mortality in Tallinn and in Riga. In Tallinn, all-cause mortality has increased by 28% (95% CI) and in Riga mortality has increased by 41% 95% (CI: 11-79%). All-cause mortality increased slowly below the seasonal MMT in both cities. Due to the choice of the function used to describe mortality, the increase is not entirely linear with similar effects between 0 ºC and -5 ºC.

In addition, significantly increased mortality was observed in the 75+ cohort (RR = 1.64, 95%, CI 1.17 -2.31 and among people suffering from cardiovascular condition (RR = 1.83, 95%, CI 1.31 - 2,55) in Tallinn (but not significant in Riga), and in the under 75 age group in Riga (RR = 1.58, 95%, CI 1.12 - 2.22). The study did not find statistically significant relationship between mortality due to respiratory diseases and low temperature periods or external causes and cold days. The cold-related attributable (death) fraction (SF) was 7.4% (95% CI: 3.7-17.5) in Tallinn and 8.3% (95% CI: - 0.5 -16.3) in Riga. These results indicate that relatively large proportion of all-age deaths in these two Northern European cities could be attributed to low winter temperatures.



a b

Figure 47: Cumulative Effect on Mortality over Time Lags between 0-21 Days for the Winter Months (November to March in Tallinn (a) and Riga (b). Shading 95% CI
Source: Åström, et al., 2019

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The amplification of future occurrence of extreme temperatures on urban population was studied by Martinez et al. (2018) in Vilnius, Lithuania and mortality projections for the near and more distant future periods elaborated. The temperatures in Vilnius during summer and winter seasons for 2009-2015 were assessed and used as baseline for projecting summertime and wintertime daily temperature for two prospective periods, one for the near future (2030 -2045) and another for the far future (2085 -2100), both under the Representative Concentration Pathway (RCP) 8.5 global warming indicators (IPCC, 2016).

Then, the historical relationship between temperature and mortality during the 2009-2015 was estimated and projected for two future periods, 2030 - 2045 and 2085 - 2100 considering changing climatic conditions and population numbers while also assuming alternatively no acclimatization and acclimatization scenarios to the heat and cold, based on a constant percentile threshold temperature. Results showed that during the baseline period 2009-2015 an increase in daily mortality was detected when the maximum daily temperature reached 30 ºC (the 96th percentile of temperature series) amounting to average seven deaths per year. Regarding wintertime cold-related mortality during the baseline years 2009-2015, an increase in mortality on days when the minimum daily temperature fell below – 12 ºC was also observed (the 7th percentile of the temperature series) with an average around 10 deaths/year.

During the near future timeline (2030-2045) the annual average heat-related mortality was forecast to reach 24 deaths/year (95% CI: 84 - 38.4), and 46 deaths/year (95% CI:16.4 - 7.4) during 2085-2100 if no acclimatisation or adaptation measures were deployed during these two periods for shielding population against hot temperatures (Figure 48). When such heat acclimatisation scenario was assumed, mortality would not increase significantly neither during 2030-2045 nor during 2085-2100. Keeping the threshold temperature constant, annual average cold-related mortality might decrease markedly during 2030-2045 to 5 deaths/year (95% CI: 0.8 - 7.9) and even more during 2085-2100, down to 0.44 deaths/year (95% CI: 0.1 - 0.8). However, when assuming a "middle ground" between the acclimatisation and non-acclimatisation scenarios, the decrease in cold-related mortality would not counterbalance the increase in heat-associated mortality. The study concludes that the increased risk of heat-related mortality will exceed the reduction in risk of cold-related deaths during both future periods. Hence, there is a growing need for public health authorities to put in place measures protecting population of Vilnius against deaths from thermal stress.

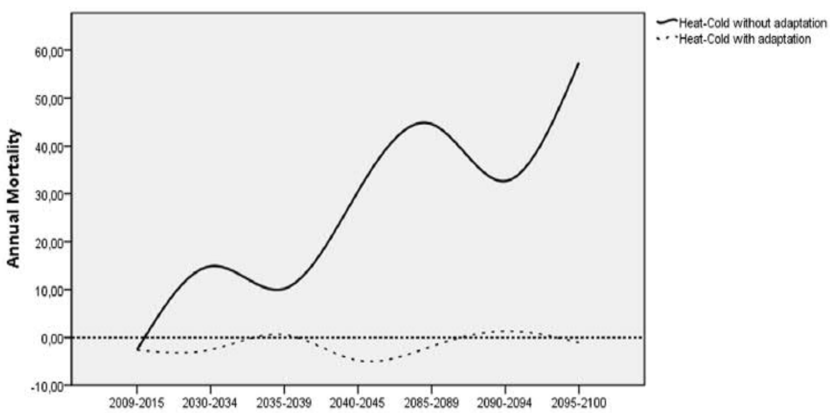

Figure 48: Time Trend of the Annual Mortality in Vilnius, Lithuania, Attributable to Heat and Cold during Different Periods of Time and Depending on Deployment and Non-Deployment of Public Health Adaptation Policy Measures
Source: Martinez et al., 2018

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The association between temperature and daily mortality was also explored among the citizens of Oslo during 1990-1995 by a study performed by Nafstad et al. (2001). Data on daily mortality were linked to daily temperature, relative humidity, wind velocity and air pollution. At temperature below 10 ºC a 1 ºC fall in the last seven days average temperature has increased the daily mortality from all diseases by 1,4%, respiratory diseases by 2.1% and cardiovascular diseases by 1.7%. Above 10 ºC there was no statistically significant increase in daily mortality, except for respiratory mortality, which increased by 4.7% per 1 ºC increase in the last 7 days average temperature. The increase starts at lower temperatures than that observed in the warmer regions of the world, but at higher temperatures than in regions with ever colder climates.

A more recent study which investigated the evolution in minimum mortality temperature in Stockholm, Sweden (Åström et al. 2016) used the variations in daily mean temperatures to investigate whether minimum mortality temperature (MMT) changed in Stockholm 2000-2009. Findings indicate that throughout the decade 2000-2009, MMT ranged from 10.3 ºC to 20 ºC (median 17.4 ºC). Relative MMT ranged from the 64th percentile to the 95th percentile of lag 0 ºC distribution (median = 90th percentile). Similar results were found from sensitivity analyses, which used 10 degrees of freedom for the time trends. The mean temperature in Stockholm increased from 6.0 ºC during 1900-1929 to 7.4 ºC during 1980-2009. The increase in both absolute and relative MMT over the entire period analysed was also observed. However, the absolute MMT during for the decade 2000-2009 reached 16 ºC which indicates that the Stockholm population might have acclimatized to gradual increases in thermal averages over this time.

4.2.1 Conclusions

The links between higher temperature amplitudes related to climate change and increase in population deaths is hard to pinpoint causally due to complexity of human reactions to atmospheric environment and the potential confounding effects of the other factors. Still, research shows that heat and cold waves are associated with lower well-being among general population and increases in mortality and morbidity among some social groups whose death toll exceeds the death numbers among general population.

The largest effect of heat waves has been observed among the elderly (75+), but in some places, also among people of all-ages including younger adults. People with disabilities are more prone to psychological stress and physical ailments induced by severe ambient conditions. Manual labourers, migrants and refugees may lack e.g., access to shelters with cooling or heating facilities and suffer the influence of air temperature.

The minimum mortality temperature (MMT) degrees vary across the regional climatic and atmospheric conditions. Risk increases slowly and linearly for cold temperature below the MMT. Risk generally escalated quickly and non-linearly at high temperatures. However, relationship between temperature-mortality can vary broadly between different regional, and administrative settings because it is also affected by techno-social standards of given location, i.e., the availability of heating at the dwellings and access to green areas which function as natural coolers and/or to mechanically cooled facilities when temperature exceeds caution level. In addition, the population's economic welfare and the quality of health-sector service do moderate the negative impacts of temperatures. The quality of public health is important to all population sub-groups.

Several studies confirm that homeless people are particularly vulnerable to variability in meteorological conditions, such as hot or cold weather and heat waves because the risk factors for

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mortality and morbidity arising from these factors correlate closely with the characteristics of homeless individuals. Homeless are often forced to live in hazard-prone areas and often lack appropriate resources to protect themselves against potentially harmful events. These characteristics make them extremely fragile and susceptible to hazard strains. Majority of homeless in the EU live in urban and sub-urban areas where they are at increased risk from heat waves due to "heat island effect".

Pre-existing psychiatric illness has been shown to triple the risk of death from extreme heat. Other risk factors for death during heat waves include cardiovascular disease, pulmonary disease, advanced age, living alone, substance abuse and cognitive impairments.

Several climate change studies do project that increasingly higher numbers of urban population will be exposed to heat-related atmospheric adversities and thus also the homeless persons because the numbers of city inhabitants in some metropolitan areas are expected to increase substantially toward 2050. Because it is likely that the frequency and duration of heat extremes such as the numbers of monthly heat records will increase, the consequence will be a marked increase in inhabitants' thermal discomfort levels in many EU cities. People in highly urbanized areas are projected to be at higher risk of heat stressors as compared to those living in rural surroundings. This might lead to higher numbers of excess heat-related deaths, unless effective adaptation policy measures are deployed.

A study exploring changes in heat/cold ambient temperature impacts on human wellbeing and death risk shows a doubling or tripling in frequency of "great discomfort" in some EU southern cities. Also, in the northernmost European cities the heat-induced discomfort is becoming increasingly more frequent. In 2015 heat waves in France caused more than 3 000 deaths alone. In Finnish studies it has been estimated that heat might become a severe threat to public health as the high temperature spells might become more frequent and more haphazard in future. Estonian study indicated that relatively large proportion of all-age deaths could be attributed to low winter temperatures. Lithuanian study concluded that the increased risk of heat-related mortality will exceed the reduction in risk of cold-related deaths during future periods. Hence, there is a growing need for public health authorities to put in place measures protecting population against deaths from thermal stress.

4.3 Links between Temperature and Mortality among Vulnerable People in BuildERS-study Countries

Below several studies are reviewed which connect the risk of death from variable temperatures to the particularly susceptible human groups such as the homeless. As indicated before, almost all people receiving humanitarian aid from the Salvation Army are *homeless*, who in addition to this hardship suffer also from the lack of residence permit, need to take care of young children, unemployment, addiction, poor mental and somatic health, and loneliness, and exclusion from many social services provided by public institutions, such as local health care system, to mention just a few.

Homeless people constitute an EU-wide subpopulation who live under conditions of perpetual disaster often leading to trauma-related disorders, which sometimes, but for limited time only, might seem as "stress-induced resilience" (Southwick et al., 2014). However, as individual resilience is primarily related to personal strength deriving from healthy life conditions which allow return to sound baseline functioning after a highly adverse event occurs, the stress-induced resilience might not protect homeless and/or other fragile clusters against negative impacts of more frequent natural events nor against life risks produced by long-term atmospheric changes inflicting not catastrophic but still deadly results (Bonanno, 2004; Bonanno et al., 2011)[8, 9].

Most of the homeless live in cities and towns, majority of them are men (FESNTSA, 2018; Baptista et al., 2017). However, growing numbers of women with young children and even single young children or young adults have joined the homeless cohorts over the last decade.

Family homelessness is revealed to be highly gendered, i.e., it was experienced by lone women parents and their children at very disproportionate rates. Unlike lone adults experiencing sustained or recurrent homelessness, homeless families were not reported as often characterised by severe mental illness, addiction or limiting illness or disability. A broad association between family homelessness and existence of poverty was reported as were associations with inadequacies of supply of affordable housing and well-paid jobs (Busch-Geertsema et al., 2010; Baptista et al., 2017).

The overview of housing exclusion in Europe (FEANTSA, 2018) provides highly disturbing statistics on the scale and human costs of homelessness in Europe. According to data presented there, 13 371 was the enumeration of estimated deaths among homeless people in France between 2002 and 2016. Average age of death of homeless person was 49.6 years, and 47 years in Great Britain. In Amsterdam, mortality among homeless people was 3.5 times higher than in population as whole and shortened by 30 years life expectancy of this very cohort as compared to general population. Rough sleepers' standardized mortality ratios could be 10-13 times higher compared to general population in the EU. The average amount of person's life spent as homeless could be as high as 10.3 years. The FEANTSA foundation has also revealed that children under the age of 18 are severely affected by homelessness in Europe. In Ireland, 3 333 children were homeless in November 2017, up 276 % since November 2014. In Sweden, between 10 000 and 15 000 children were homeless in April 2017 which displayed 60% increase in emergency accommodation between 2011 and 2017. In 2015 4 000 children were registered as homeless in the Netherlands, 60% increase from the year 2013.

The longer a person stays homeless the more likely she/he would suffer from cancer, cardiovascular and respiratory diseases, accidents, intoxication and/or danger of suicide. Homeless people also experience severe poverty and oftentimes come from disadvantaged minorities, the factor that independently is associated with poor health (Ivers et al. 2019).

Homeless people belong to a segment of the EU population which is highly susceptible to excess mortality caused not only by distinctive natural perils but also by seemingly not dangerous ambient variability. We collected some statistics to approximate the scale of these people's plight in different BuildERS countries and to substantiate the need for more in-depth exploration of these people life threatening hazards by the BuildERS international survey.

Although homelessness statistics in the EU are quite sketchy, they indicate that the numbers of people sleeping rough have risen during 2013-2017 and so did their mortality attributable to atmospheric and hydrological severities, at least in the locations reviewed. The tableTable 7 below provides some

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[8] For comprehensive review of definitions and content of "individual resilience construct" see Southwick et al; 2014.
[9] This definition of resilience is not promoting "*ableis*t" which according to Amundsen and Taira (2004) is a doctrinal posture that "falsely treats people with impairments as inherently and naturally horrible and blame the impairments themselves for the problems experienced". For a comprehensive review of issue of ableism as "ideas, practices, institutions and social relations that presume "able-bodiness" and by so doing construct people with disabilities as marginalized and largely invisible "Others", see Kumari-Campbell, F., (2008) "Refusing Able(ness): A Preliminary Conversation about Ableism", M/C Journal, 11, 3, pp.1-5

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estimates of the scale of homelessness problem in selected EU countries. The homeless stock of population is divided into three categories – the individuals who are natives of the home country, the households with several members (could vary between two and more) residing in the home country but also with foreigners, and the refugees/migrants registered by the national authorities or by the care and shelter providing NGOs. The counts were done at different points in time during 2013, 2016 and 2017. Data were retrieved from the "Global Homelessness Statistics" Europe chapter (Homelessness World Cup Foundation). In this context it is essential to stress that enumeration of homeless migrants might not be reliable because it requires "counting the uncountable" due to the fact that such persons usually avoid public scrutiny (Triandafyllidou, 2010). Thus, to the degree these figures include irregular migrants who remain unregistered, they are severely underestimated because such persons seek to be invisible.

Also, impacts of natural disasters and atmospheric variability disproportionally place persons with disabilities and their families in life threatening situations. Persons with disabilities, who might live with their families, could be helped during evacuation and during post-disaster recovery. However, empirical evidence from several natural disasters (Center for International Rehabilitation (2005), World Health Organisation (2005)) and other studies (Hemingway and Priestley (2006)) reveal that disabled people are at greater risk of injury, mortality, disease, destitution and displacement when compared with general population, even in highly developed countries. Hemingway et al. (200) concluded that "the disabled people's lives were put adversely at risk, not simply by individual limitations but by social and environmental factors. These included the dangers of buildings and facilities used by disabled people, an absence of specific evacuation lanes and transport, inaccessible warning information and sometimes the negligence at the part of neighbours, staff and rescue workers". Further in the face of climate change, and in the times of environmental and/or humanitarian disasters, the relative poverty of persons with disabilities, combines with the problems listed and may precipitate greater illness and even death (www.disability-europe.net).

Table 7: Estimated Numbers of Homeless People in Some EU Countries/Cities Broken Down by Status and Year of Enumeration (2013, 2016 and 2017)

Country	Native Individuals	Native Households	Refugees/ Migrants	2013	2016	2017
Austria	X		X		35 900	
Belgium/Brussels	X	X			3 386	
Finland	X		X			7 112
France	X	X	X	103 000		
Germany	X	X	X			860 000
Greece	X	X				21 216
Netherlands	X	X			31 000	
Norway	X		X		3 909	
Poland	X					30 408
Portugal	X			4 420		
Romania/Bucharest	X			6 000		
Spain	X	X				31 000
Sweden	X	X				33 250
Switzerland/Zurich	X		X			4 801

Source: Homelessness World Cup Foundation. Global Homelessness Statistics, Europe

Records in the table above are not consistent. Some refer to entire countries while others to cities with large concentration of homeless stock. Two large EU countries, France and Germany with large

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subpopulations of those who live on streets, do not inform how these groups are distributed across large cities or towns. However, as homeless people do not seek visibility, this might contribute to registration variance. An example below (Figure 49) shows that statistics over the numbers of refugees (native and external) in Germany during 2011-2018 compiled by Statista diverge from the Global Homelessness Statistics, Europe.

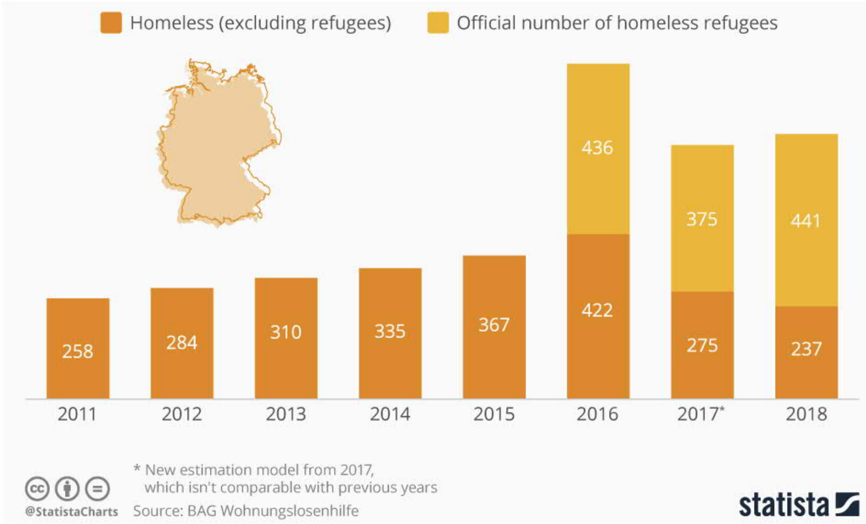

Figure 49: Homelessness in Germany
Source: Statista, 2019 at Statista.com/chart/19932/estimated-number-of-homeless-people-in-germany/

Another method for assessing the scale of homelessness in some EU countries is by counting the individuals who use shelter every night because of 1) personal emergency arising from needs for lodging and/or weather conditions and/or 2) the lack of other accommodation. Data were collated by the Habitat for Humanity International agency (HHI- https://wiki2.org/en/Habitat_for_Humanity) which recorded the stock of homeless populations at any given night (Table 8). However, these data might not be directly comparable across countries as different definitions of homelessness are applied in national statistics[10]. Still, these records provide some insights into the scale of the problem at country levels.

[10] Habitat for Humanity is an international, non-governmental and nonprofit organization which since its foundation in 1978 has helped 29 million people to construct, rehabilitate and acquire homes and houses. https://wiki2.org/en/Habitat_for_Humanity

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Table 8: List of Countries by Homeless Populations

EU Country	Homeless Population per night	Data year	Homeless per 10,000
Austria	14, 603	2014	17
Croatia	3,000	2018	7
The Czech Republic	23,830	2019	22
Denmark	6,636	2017	11
Estonia	864	2011	6
Finland	5,482	2018	9
France	141,568	2012	21
Germany	650,000	2017	79[11]
Hungary	10,068	2014	10
Ireland	10,338	2019	21
Italy	48,000	2014	8
Latvia	2,342	2011	11
Luxemburg	1,533	2013	28
Netherlands	39,300	2018	23
Norway	3,909	2016	7
Poland	30,330	2019	8
Portugal	3,396	2018	3
Romania	15,000	2004	7
Slovenia	2,700	2015	13
Spain	40,000	2012	9
Sweden	34,000	2011	36
Switzerland	3,000 – 8,000	2016	3-9

Source: https://wiki2.org/en/Habitat_for_Humanity

Inspection of data in table above indicates that the Czech Republic, France, Germany, and Ireland have registered the highest numbers of homeless people per 10 000 inhabitants, although the counts vary by years and it's impossible to assess how these numbers varied over time.

FEANTSA statistics (2018a) shows that 50 724 persons were registered as rough sleepers without roof over head in 2017 in Italy (Table 9). The characteristics and conditions which contributed to become a "homeless person" were explored and revealed the social profile of people falling under this category and mechanisms contributing to homelessness. A typical homeless person was a man (87.5% of the sample polled), a migrant (58.2% of sample pooled), living in Northern Region of Italy (56.0%) and a single (76.5%). He was 44-year-old on average (although migrants were younger than Italians). He worked few hours during a week earning an average € 300 per month. He lived on a street for a long time (2.5 years). He suffered from 1) lack of stable relationship with family and/or friends, 2) personal trauma, 3) inability to work causing long-term unemployment, and 4) some social and/or behavioural disorders.

Divorce and/or separation from the primary family caused by migration of younger males were among the most important triggers of homelessness and mental strain. The FEANTSA (2018a) homeless data from 2017 show that only 14% of 50 724 homeless people were affected by severe physical condition or mental and/or communication disorders. Women constituted 14.3 % of homeless

[11] Includes around 375,000 asylum seekers and refugees in temporary accommodation.

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subpopulation in 2017. They had similar socio-demographic characteristics as men (divorced, separated, personal trauma related to forced separation from children). The highest concentration of homeless persons was in Milano (12 004), in Rome (7 709) and in Palermo (2 887). These findings were confirmed by dataset collected by CARITAS Italy in 2017 which polled the users of its homeless counselling services. According to CARITAS records, 28 697 persons used counselling services in 2017 and demographics of this cohort are presented in table below.

Table 9: Homeless People Encountered into the CARITAS Counselling Services in Italy, 2017

Homeless People Demographics	**Percentage Share**	**Homeless People Demographics**	**Percentage Share**
Regional Macro Areas		***Marital Status***	
Northern	64	Married	34
Centre	24	Unmarried	43
Southern	12	Separated	9
Gender		Widowed	7
Men	70	Other	3
Women	30	***Educational Level***	
Age		No Title or Primary Education	30
Under 18	0.2	Lower Secondary Education	40
19-34	33	Upper Secondary Education	25
35-44	23	Bachelor	5
45-54	24	***Occupational Status***	
55-65	15	Employed	8
Over 65	5	Unable to Work or Retired	4
Average Age	42	Unemployed	80
Nationality		Irregular Jobs	2
Italian	33	Other	6
Foreign	67		

Source: FEANTSA, 2018a.

The temperature impacts on human well-being, health condition and mortality might vary within the temperate climate zones where the Baltic countries, Ireland, Italy, Germany and Poland are located. Even small increases in cold and heat stressors might be fatal for homeless people. Research shows that environmental conditions became a significant independent mortality risk factor for homeless cohorts, in addition to, or in combination with circulatory, respiratory and infectious diseases and addiction-related sickness. As mentioned, homeless people are particularly prone to some addictions, and have significantly shorter lifespan as compared to general population. Further, rough sleepers often die of different causes than do members of general population. The below reviewed studies of relationship between ambient conditions and mortality among homeless people in Poland, Ireland, France, UK and Canada confirm these subgroups' extreme fragility and needs for stronger protection.

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A study by Romaszko et al. (2017) has analysed mortality causes of 176 homeless people who died during 2010-2016 in the city of Olsztyn in north-east Poland (Figure 50). The average life span of a homeless person was shorter by about 17.5 years than that of general population. The most frequent cause of death were circulatory system diseases, conditions related to smoking, and infectious diseases like tuberculosis. To characterize the association between the weather and the deaths, meteorological data on minimum and maximum ambient temperatures and the Universal Thermal Climate Index (UTCI) were applied. The largest number of deaths occurred under conditions of cold stress (of different intensity). Deaths caused by hypothermia were thirteen-fold more frequently recorded among the homeless cohort than among general population. A relative risk of death for a homeless person even under moderate cold stress condition was higher (RR = 1.84) than that under thermoneutral conditions, i.e., when the UTCI values remained within the range of 9.1 ºC and 26 ºC.

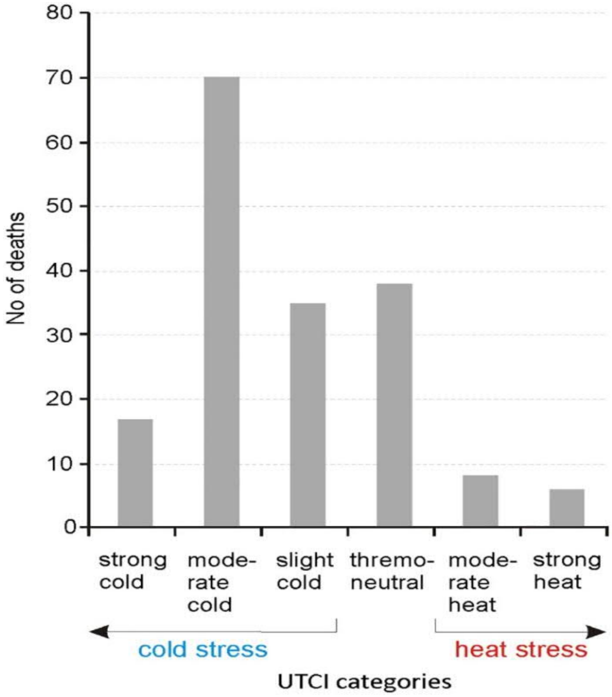

Figure 50: Number of deaths in categories of thermal stress according to UTCI
Source: Romaszko et al., 2017

Higher Relative risk (RR) of death among homeless people when temperature went down was also corroborated by the French study (Vuillermoz et al. 2016). Out of 1 145 homeless registered death during 2008-2010, 693 cases were matched with database repositioning causes of death. Log-binominal regression was used to compare mortality among homeless to that of the general population. The homeless people who died were 49 years old on average, compared to 77 years old in the general population during 2008 -2010. Overall, homeless death rates were slightly higher during winter. Among homeless cohort the risk of dying from hypothermia was the highest (RR = 6.4). Deaths associated with alcohol intoxication (RR= 1.7) were less likely, while RR of deaths attributed to mental disorder, diseases of digestive and circulatory systems and undetermined causes varied between 1.5 to 3.7.

Data on deaths of people who experience homelessness in Dublin Region in Ireland were analysed (Ivers et al. 2019). Based on the study 209 deaths were recorded during 2011-2015 among homeless people with 156 deaths verified as males (77.6%). Drug and alcohol-related poisoning were among the leading causes of death and accounted for 38.4% of deaths. Although the authors did not explicitly analyse the association between mortality and temperature, they have however observed that at least

20 % of deaths registered occurred when temperature dropped to - 3 ºC and that all these deaths could have been avoided if the emergency accommodation was provided by the Dublin City Council. In addition, the Irish Examiner newspaper from December 14th, 2019 also observed that the Dublin city councillor could not offer enough temporary lodgings to shelter all homeless citizens during period of 2018-2019 winter frost.

Finally, to better understand the risk of cold-weather injuries among vulnerable sub-populations, a study by Zhang et al. (2018) was reviewed. According to the study, people experiencing homelessness face an increased risk of cold-related injuries like frostbites or hypothermia that can lead to severe morbidity or death. The results revealed that the rates of cold-induced injuries among homeless men were much higher than among homeless women in Toronto during the winter season 2013. Also, the rate of cold-related injuries among homeless men were significantly higher in comparison to their housed low-income peers (Zhang et al. 2018). After demonstrating highly elevated level of risk for cold-related injuries or even mortality among homeless and low-income cohorts in Toronto, the study proposed several public health interventions. They included the relaxed shelter restrictions to decrease the number of individuals staying outdoor during high frost days, an increased deployment of street outreach teams, distribution of transit tokens to help people travel to shelters at city outskirts, and addition of shelter beds during cold weather emergency.

4.3.1 Conclusions

Homeless people constitute an EU-wide subpopulation who live under conditions of perpetual disaster leading to trauma-related disorders. Individual resilience is primarily related to personal strength deriving from healthy life conditions which allow return to sound baseline functioning after a highly adverse event. The stress-induced resilience might not protect homeless and/or rough sleepers against negative impacts of more frequent natural events nor against life risks produced by long-term atmospheric changes imposing not catastrophic but still deadly risks.

Impacts of natural disasters and atmospheric variability disproportionally place persons with disabilities and their families in life threatening situations. Persons with disabilities, who might live with their families, could be helped during evacuation and during post-disaster recovery. Disabled people are at greater risk of injury, mortality, disease, destitution and displacement when compared with general population, even in highly developed countries.

Most of the homeless live in cities and towns, majority of them are men. However, growing numbers of women with young children and even single young children or young adults have joined the homeless cohorts over the last decade. Family homelessness is revealed to be highly gendered, i.e., it was experienced by lone women parents and their children at very disproportionate rates.

Homeless people belong to a segment of the EU population which is highly susceptible to excess mortality caused not only by distinctive natural perils but also by seemingly not dangerous ambient variability. The longer a person stays homeless the more likely he/she would suffer from cancer, cardiovascular and respiratory diseases, accidents, intoxication and/or danger of suicide. Homeless people also experience severe poverty and oftentimes come from disadvantaged minorities, the factor that independently is associated with poor health.

Although homelessness statistics in the EU are quite sketchy, they indicate that the numbers of people sleeping rough have risen during 2013-2017 and so did their mortality attributable to atmospheric and hydrological severities, at least in the locations reviewed.

Characteristics and conditions that contributed to becoming a “homeless person” were assessed in Italy. A typical homeless person was a man, a migrant, living in Northern Region of Italy and a single. He was 44-year-old on average. He worked few hours during a week earning an average 300 € per month. He lived on a street for a long time and suffered from lack of stable relationship with family and/or friends, personal trauma, inability to work causing long-term unemployment, and some social and/or behavioural disorders. Divorce and/or separation from the primary family caused by migration of younger males were among the most important triggers of homelessness and mental strain. Only 14% of homeless people were affected by severe physical condition or mental and/or communication disorders. Women constituted 14.3 % of homeless subpopulation. They had similar socio-demographic characteristics as men (divorced, separated, personal trauma related to forced separation from children).

In Ireland, the authors have observed that at least 20 % of deaths of homeless occurred when temperature dropped below - 3 ºC. According to the epidemiological statistics, the impacts of extreme weather such as cold and/or heat waves and hydrological and fire hazards, plus some other pathologies were quite preponderant death causes among homeless. The most important cause of death of homeless people were freezing, heat strokes causing hyperpyrexia, drowning and burning. The biggest rise in dead numbers was linked to drug-related deaths. However, most of these deaths could also be attributed to cold stress, which especially hardly hit “new comers”, i.e., people who were newly released from prisons and hospitals without having an opportunity to relocate to their own or emergency dwellings or immigrants without recourse to public support.

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5. IDENTIFICATION OF INFORMANTS FOR PILOT STUDY AND INTERNATIONAL SURVEY

This chapter lays out methods for how the BuildERS project research team will recruit survey respondents from among the Salvation Army's service recipients composed of highly diverse sub-populations, groups and cohorts[12]. To capture the impacts of seldom hazards, it is necessary to design multiple level studies, where stronger stratification is applied to reach people at the different hazard discharge levels and ensure that all affected human strata are identified at the geospatial scales and accessed.

5.1 Rationale for Studying Severely Vulnerable People

BuildERS will disclose how the social and official exclusion that the severely vulnerable people suffer from might affect their capabilities to cope with and recover from natural and man-made hazard adversities. The international research reviewed in D1.2 and D2.1 as well as results from epidemiological investigations confirm that certain individuals or groups suffer from severe marginalization which make them particularly vulnerable to health and life threats imposed by the changing atmospheric conditions, even before any disaster occurs.

The BuildERS spotlight on the most vulnerable individuals is driven by a need to find more about these persons' life conditions and interplay between factors that impair their ability to cope with crises and disasters. Consequently, BuildERS will initiate a discussion on vulnerable people who lack social and political recognition and are excluded from publicly voicing their needs. This objective requires good understanding of vulnerability mechanisms that might affect all individuals but operate as particularly severe stressors for some groups suffering from multiple life hardships. This issue has not yet been explored adequately.

Thus, the access to highly heterogeneous marginalized groups will allow the BuildERS project to assess the differences not only within their sub-populations but also between the different national cohorts whose life conditions are affected by socioeconomic and institutional structures of the countries they live in. This approach allows to discern the impacts of techno-social and political systems on vulnerability forms and levels, and how these pre-event conditions might increase the post-hazard severities.

The contribution of the Salvation Army as major humanitarian partner will consist in facilitating access to hard-to-reach vulnerable individuals and groups that benefit from the agency's service offerings in different national settings. This variation will allow to compare, for instance, what role ethnic

[12] In research and statistics, the term cohort relates to a group of individuals who share some characteristics at some specific time, such as migrant+ illiterate + homeless, or unregistered refugee+ jobless + suffering from psychiatric disorder who are discerned to assess, what immediate and long-term impacts these people's exposure to natural and man-made hazards did inflict on their health and overall wellbeing (McGraw-Hill Dictionary of Modern Medicine, 2002 by The McGraw-Hill Companies, Inc.)

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composition, and governmental social policy, etc., play in occurrences of specific vulnerability forms and impacts on various client groups.

5.2 Respondents' Access and Recruitment

Social stigma builds invisible walls between vulnerable people and society at large. It also holds back researchers from exploring how the lack of access to safety, health care, social networks and education that marginalized individuals suffer from might impact on their capabilities to cope with and recover from the natural and man-made adversities. Fortunately, the BuildERS project consortium has the Salvation Army among its partners. The agency operates humanitarian aid stations in 26 EU countries and its service providing workers consented to facilitate access to the agency's clients and carry out the survey interviews at the premises of service stations.

The social capital of vulnerable groups is often jeopardized by the lack of family, broken relationships with community (due to addiction and transient life style), individual impairments, as well as being legally or financially excluded from public entitlements. Thus, to help these people in surviving, the humanitarian aid organizations such as the Salvation Army step in.

The services provided by Salvation Army to disadvantaged people in Europe include feeding schemes, post-event emergency rescue and relief, prevention of human-trafficking and awareness building, children and elderly care, work with internally displaced persons, women's education, work with families of disabled people, rehabilitation programs for the mentally impaired, emergency housing for newly homeless, hostels and night shelters for rough sleepers (men and women), accommodation for homeless mothers with children, addiction treatment and prevention, social rehabilitation, medical care, job-training, primary education for illiterate persons, prison visits, financial help and debt counselling, language and integration courses, nursery, missing person search, support to refugees and migrants (both individuals and families), and many others.

The Salvation Army's more than 2, 000 officers and even more numerous working envoys, soldiers, adherents, medical professionals and volunteers serve every year over 2.5 million vulnerable people whose basic survival needs are not met by governmental or private welfare providers.

The BuildERS DOW maintains the collectives of the Salvation Army's service recipients constitute the candidate population from which two samples will be drawn. The first, a small one, composed of 10-20 respondents will be used for piloting, testing and validating the utility of data collection instrument before the full-fledge survey could commence. After the utility of instruments is verified, the second, larger sample will be derived from the different subgroups of the Salvation Army's service consumers to gather data on these cohorts past hazard encounters in 14 country locations and beyond. The actual number of respondents surveyed will be agreed with the officers at the Salvation Army's EU headquarters. The plan is to obtain a minimum 40 high-quality responses from each country surveyed.

Yet, several conditions are attached to access to the Salvation Army's client population. The survey questionnaire needs to be translated to at least 14 native languages spoken in the countries from which data will be collected. Additional translations to non-European languages might also be needed.

The survey-questionnaire instruments should be reviewed and approved before fieldwork will start by each country's ethical evaluation committee or research ethics supervising board. Any revision of the instrument content or form should be subjected to separate scrutiny and approval by the committee in question before any data collection could commence.

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Further, the participation in the study by any of Salvation Army's client should be voluntary, and the data collection process should adhere to stringent ethical rules for querying distressed and/or destitute persons. In this regard, additional ethical trainings for interviewers were provided. The interviewers should show respect for informants' decisions to withdraw from the interview at any time at their convenience, provide safety and security to people queried, and assure that the data gathered are well protected and stored safely at secured servers with only authorised research personnel having access to data processing and analyses. When requested, the records should be destroyed. Figure below presents a plan for selection of survey respondents to international survey in WP3 T3.2 and T3.3.

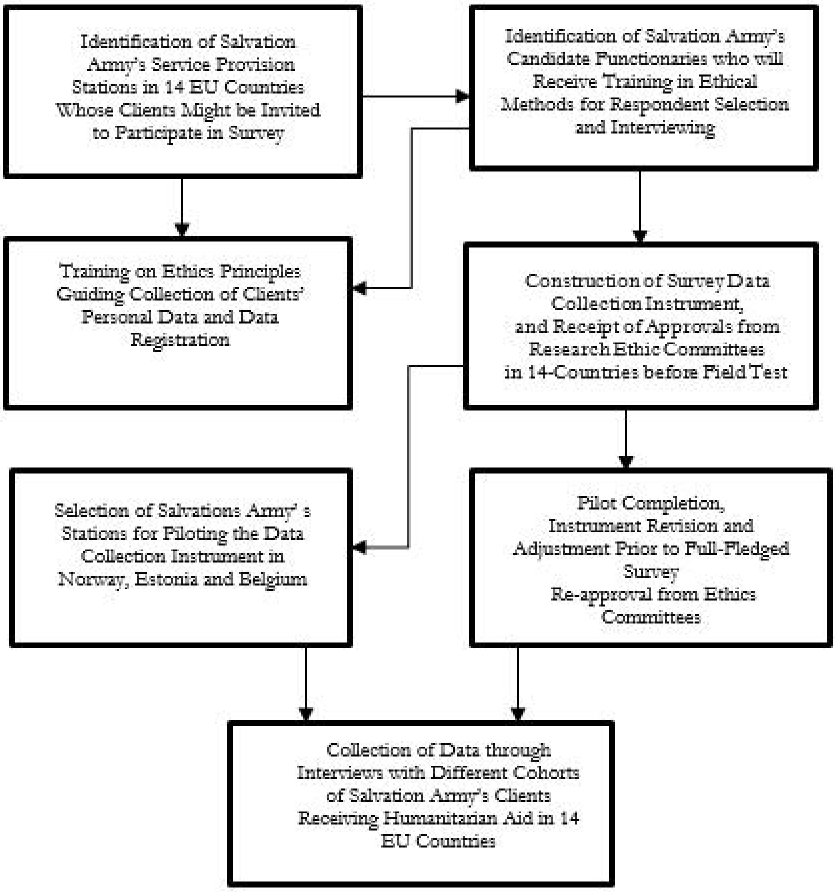

Figure 51: Procedures for Respondent Selection to WP3 T3.2 and T3.3 International Survey
Source: BuildERS Elaboration

This method for accessing the prospective respondents might produce several methodological benefits. First and most prominent is that it might enable the researchers to survey a population for which a sampling frame does not exist. Second, since the Salvation Army's service providers know the background and conditions of their clients, they might also select different proportions of respondents who experienced different hazards thus warranting high sample variability and high hazard coverage. This selection technique might enhance the internal and external validity of the survey findings while at the same time reduce the biases associated by convenience sampling and random street recruitment. Finally, since Salvation Army functionaries know the number of different categories of service recipients, the findings could be attributed to different subpopulations and, after

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syntheses, to the entire Salvation Army's client population at a given point in time in the target EU country, and subsequently, to the EU level (Kim and Handcock, 2021).

5.3 Geographical Areas of the Study

As observed, members of disadvantaged subpopulations whose hazard experiences will be registered and documented by WP3 survey, will be invited to participate as survey respondents. Predominantly, recruitment sites will be cities and urban areas in the BuildERS project consortium countries where the Salvation Army's aid apparatus is located. In addition, other countries and cities which host other NGOs might be considered, when needed. The selection of these groups will be based on 1) local knowledge of Salvation Army's personnel providing rescue and relief to hazard-affected and socially deprived groups, and 2) integrated maps showing where and with what severity the different hazard events hit during 2015-2019. Map below shows the EU locations of Salvation Army's humanitarian service provision infrastructure from which survey respondents will be derived.

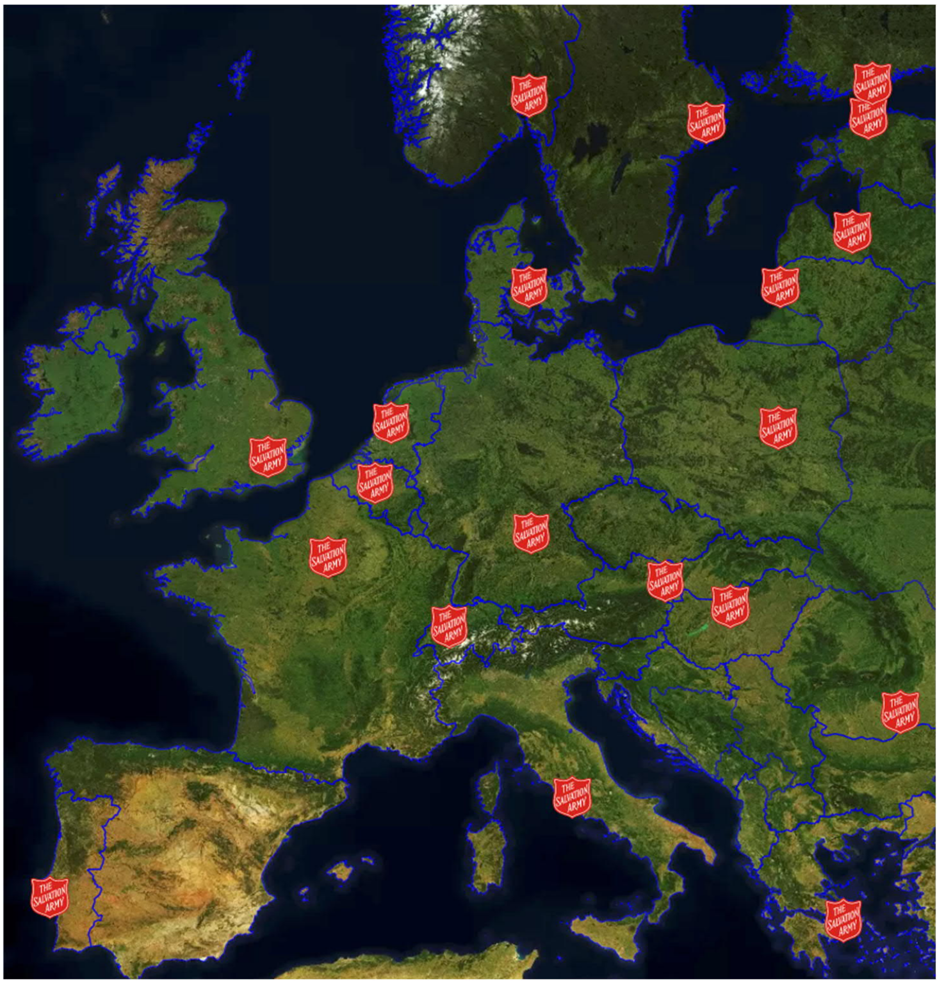

Figure 52: Locations of the Salvation Army's Headquarters in Selected EU Countries
Source: Own Elaboration

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Table 10: Cities with Salvation Army's Service and Shelter Facilities from Among Which Respondents Might Be Recruited

Country	Cities
Norway	Oslo, Bergen, Bodø, Haugesund, Trondheim, Stavanger, Fetsund, Mandal, Tønsberg,
Germany	Hamburg, Frankfurt, Cologne, Dresden, Göttingen, Wiesbaden, Neuenburg, Freiburg, Kassel, Lübeck, Stuttgart, Munich, Berlin
Finland	Helsinki, Espoo, Tampere, Turku
Estonia	Tallinn
Italy	Rome, Piedmont, Tuscany
Greece	Athens
Hungary	Budapest
Romania	Lasi, Ploiesti
Lithuania	Lietuwoje, Klaipeda
Austria	Vienna
Czech Republic	Prague, Brno, Jirkov, Krnov, Sumperk, Opava, Ostrava, Havirov, Jirkov, Prerov, Karlových, Varech
Slovakia	Bratislava, Plavecky Svrtok
Belgium	Brussels, Liege
France	Paris
Denmark	Copenhagen
Netherlands	Amsterdam, Groningen, The Hague
Spain	Barcelona
Portugal	Lisbon

Source: www.salvationarmy.org

The areas selected should represent BuildERS-study countries and cities where the Salvation Army's social aid networks operate and offer services to the vulnerable groups. The interviews will be carried out in locations where severe hazards have occurred in recent years.

5.4 Effectiveness versus Ethics

Selecting groups considered to be vulnerable, without detailed information about the individuals that constitute these groups, raises ethical concerns as to the rights of each individual to be treated equal to individuals who are not included in the group in focus, and who might be denied whatever benefits a given study produces.

Non-discriminatory rules and regulations, and equal treatment of persons that are in the same situation is covered by law and strengthened by global regulations (UN 2021).

At the same time needs for effectiveness of public rescue operations, allocation of scarce public resources to preparedness building and maximizing the overall benefits to society are also a concern. Targeting groups that have a statistically determinable over-exposure, or who have previously been identified as being affected more deeply, justifies a concentration of efforts, and positively skewed resources that are less egalitarian but more successful. Such concentration of efforts could be regarded as positive discrimination of groups who suffered most.

In the BuildERS project the conflict between effectiveness and treating each-individual respondent in a non-discriminatory fashion is actualized. The impact of a natural disaster may be quite uneven for site locations where buildings and dwellings are distant from each other. Not everybody in an area

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will become affected by a disaster. From a statistical point of view the location, even some time after the hazard occurrence, is still a site for interviewing disaster survivors because there is still a statistical higher chance of obtaining relevant eyewitness with personal experiences.

Not all homeless people are in the dangerous situation, and the reason for lacking a residence can wary a lot from case to case. However, from a statistical point of view, homeless are subject to much higher risk of mortality and morbidly than persons suffering from other hardships. It thus makes sense to stratify or preselect interviewees in areas from amongst groups that are more susceptible. When selecting “vulnerable” groups BuildERS has an obligation to make the best use of public funding available for collecting the data from hazard survivors. Areas and groups are consequently selected where there is a statistically higher chance of obtaining relevant and actionable information.

This does not constitute a pre-judgement of the individuals that are selected as part of a group or an assumption that the group is uniform. On the contrary it is indeed the objective of the interviewing itself to clarify the subjects’ actual experiences and focus on how to increase the resilience of each-individual based on their personal experience, and in a statistical sense, thereby increase the resilience of the “group”.

5.5 Conclusions

Above a rationale was presented for the WP3 strategy for recruitment of socially marginalized informants to an international survey investigating how these persons might have coped with adversities inflicted by natural and man-made hazards. Reasons for shining the light on the Salvation Army clients is that they lack many necessities, sometimes even legal residence status, before a hazard strikes. These conditions make them also hard-to-reach for scientific pursuit. Using standard population assessment methods and sampling procedures will not work in this case. In addition, due to exclusion and social stigma attached, they might refuse to release personal information to protect their own or other’s privacy. Thus, the contribution of the Salvation Army as BuildERS partner is invaluable because the agency enabled research team to access the respondent candidates by creating safe interview settings for individuals, who otherwise seek to remain “invisible” from public scrutiny. Without the Salvation Army’s help, the access to vulnerable collectives in 14 EU countries would not be possible. Nor would the recruitment of viable informants to the WP3 international survey be feasible thus precluding probing into how these persons were affected by perilous hazards in the EU. Also, considering that many of these people also suffer from homelessness, or lack of stable lodging are increasing, they are also more exposed to climate-inflicted atmospheric extremes which inflict higher toll on their lives. Combination of slow motion- atmospheric dangers and abrupt-onset hazard outbreaks, might thus considerably reduce their coping abilities.

However, still another rule for survey recruitment derives from evidence that Salvation Army’s clients live in different countries where they encounter various categories of social, economic, political and institutional barriers and stigma, which might differentiate these persons hazard susceptibility. Therefore, another consideration guiding the sampling procedures would be to skew the informant selection process toward over-exposed sub-populations, i.e., those who have been previously shown to be affected most deeply and suffered from premature deaths. This indicates that homeless individuals might be more broadly represented within the informant samples surveyed by WP3 T3.3.

This procedure might however give raise to a conflict between effectiveness and treating each vulnerable individual in non-discriminatory fashion. However, such bias might be justified by improved effectiveness of public rescue operations and the benefits to the society at large arising from concentration of efforts on vulnerable groups which from statistical point of view suffer most from the morbidity and mortality risks of. It thus makes sense to stratify or preselect the highest hit hazard locations from among all those hazard-stricken and the social groups who are among the most exposed to such hazards.

Taking stock of the above, the respondents will be recruited from cities and/or urban areas where the Salvation Army's aid apparatus in 14 EU countries is located, and where the occurrences of most damaging natural and/ or other hazards have been recorded.

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6. SUMMARY AND CONCLUSIONS

D3.1 presents results from the WP3 preparatory work proving empirical and geospatial knowledge for the pan-European survey exploring how the recent natural and man-made hazards might have affected safety and life quality of the severely vulnerable people in the EU. The report reviews the different disaster impacts, and a multitude of human and socio-economic conditions which made certain subpopulations severely susceptible to hazard perils.

This mandate derives from the BuildERS project's overall objective to increase the social security and safety for the most vulnerable groups by improving their life status and facilitate access to social and human capital. The project will create new knowledge informing social policy makers how to strengthen social capital and resilience against hazards of the EU communities exposed to climate change, but foremost those who already have suffered from disaster adversities.

Technically, the study will help in defining variables for the BuildERS' survey questionnaire and locating the hazard-affected people whose rescue and aid needs have not been met by the institutional actors, but by the Salvation Army's and/or other NGO's humanitarian aid apparatus.

D3.1 has revealed disparity among hazards impacts and harms afflicting several heterogeneous cohorts in relative poverty and suffering from multiple morbidities (psychopathologies, cardiovascular and respiratory diseases), in addition to protracted social exclusion. Because of their frailty, these people are ten-folds more susceptible to climatic and ambient impacts and become easy prey to premature deaths after encountering natural or other stressors (even those which do not cause immediate physical damage). Testimony from these people's past hazard encounters might substantiate fortification of civil, social, medical and technical protection against natural dangers and improve collaboration between the NGOs and civil protection providers.

6.1 European Disasters

The review reveals that in general, the large-scale catastrophic damages inflicted by severe disasters are not so frequent in Europe, apart from earthquakes, and volcanic eruptions in Southern Europe, where they have caused most of the deaths and the highest material and structural damage. In 2016, over 300 people died in earthquake in Italy.

Also, climatological disasters, such as wildfires, are quite common in Southern Europe, and they cause casualties. In addition, fire damages might cause large-scale impoverishment and loss of economic livelihood for many EU citizens and reduce welfare standards for the entire country. Also, the time-deferred or the second-order disaster consequences such as the loss of industrial assets and/or critical infrastructure devoid the affected populations from economic opportunities, plunging many into poverty and emigration. However, some people do not have homes at all, their houses are not built well, or infrastructure in hazard prone areas is poor. Thus, public investments in hazard-resilient human dwellings and other critical infrastructure plus more effective public health care might improve the general level of preparedness and reduce future damages.

However, almost entire Europe, except the northernmost areas, suffers from meteorological variability, such as cold periods and heat waves. These phenomena multiply the toll of human deaths. During the study period, over 700 people lost their lives in Western Europe due to heat waves and cold spells, while almost 6 000 in Eastern Europe. Yet, it needs to be said that many "invisible" people

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might have perished from comorbidities and not solely from atmospheric stressors. Their deaths might not have been registered as related to meteo-events. The choice of the WP3 survey study areas and the natural hazard discharge sites have revealed that European countries' hazard exposure vary broadly. The Nordic as well as the Baltic countries suffer less from catastrophic events than other parts of Europe. Storms and consequential floods are frequent events in wealthy Central Europe. As the standard of living in the Eastern Europa are lower than in Europe on average, people there are more vulnerable to heat waves and cold periods, but also to flood destructions. The southern part of Europa also suffers more from deadly wildfires, earthquakes, and infrequent volcano eruptions.

6.2 People Affected

The links between temperature variability and human mortality are hard to pinpoint causally due to complexity of human reactions to atmospheric changes and the potential confounding effects of the other factors. Still the research shows that heat and cold waves are associated with lower well-being among general population and excessive mortality and morbidity among highly marginalized social groups whose death toll exceeds mortality rates of population at large. The same catastrophic impacts are attributed to climate related seasonal shifts in the low and high temperatures which, despite not being highly materially destructive, still inflict many excess deaths, particularly on those who lack resources to protect themselves adequately.

The largest effect of heat waves has been observed among the elderly (75+), but also among people of all-ages including younger adults. People with disabilities are more prone to psychological stress and physical ailments induced by severe ambient conditions. Manual labourers, migrants and refugees may lack e.g. access to shelters with cooling or heating facilities and thus might suffer more from air temperature changes.

Several studies confirm that homeless people are particularly vulnerable to meteorological variability, such as hot or cold weather because the risk for mortality and morbidity arising from these factors correlates closely with the characteristics of homeless individuals. Homeless are often forced to live in hazard-prone areas and lack appropriate resources to protect themselves against potentially harmful events. These characteristics make them extremely fragile and susceptible to hazard strains. Majority of homeless in the EU live in urban and sub-urban areas where they are at risk from heat waves caused by the "heat island effect".

Several climate change studies do project that higher numbers of urban population will be exposed to heat-related atmospheric adversities over time and thus also the homeless persons because the numbers of city inhabitants are expected to increase substantially towards 2050. Because it is likely that the frequency and duration of heat extremes such as the numbers of monthly heat records will increase, the consequence will be a marked increase in inhabitants' thermal discomfort levels in many EU cities. People in highly urbanized areas are projected to be at higher risk of heat stressors as compared to those living in rural settings. This might lead to higher numbers of excess heat-related deaths, unless effective adaptation policy measures are deployed.

According to the EEA report on economic losses from natural hazards during 1980-1987, the average annual economic loss (inflation-corrected) was around € 7.4 billion per year in the 1980. In the next decades it was about € 13.4 billion and in the 2000s about € 14.0 billion per year. In the period 2010-2017 the average annual economic loss amounted to around € 13.0 billion. So, the level of damage costs looks quite stable (EEA 2020). However, one needs remembering that only about

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50 % of material and economic assets are insured before a hazard strikes, indicating that the real loss values could be 50 % higher.

During the longer period, the heat and cold period events have inflicted the 68 % of all deaths, while the floods and storms have inflicted 62 % of the total losses and 90 % of the insured losses.

When studying fire hazards during 1945-2016 it seems that Southern Europe has recorded the highest number of victims in Europe. According to the Eurostat, these regions also are burdened by poverty and social exclusion. It looks that the civilians who die in wild fires are the elderly, children or those who have difficulties to evacuate from the blaze. Interestingly, girls under 20 years are more often the victims of fires than are boys of same age. Yet, it is important to underline that fires produce homelessness and damage economic and industrial base in locations scorched. More, the hazard statistics do not account for the statistical value of lives lost and the long-term humanitarian, social and economic harms imposed by these losses.

Thus, accounting only for immediate hazard impacts might underestimate the scale and scope of human long-term suffering, loss of income, accommodation and, generally, the dramatic decline in life quality. The magnitude of these adversities is empirically confirmed by the fact that over 2.5 million people yearly turn for food, aid and shelter to the Salvation Army's humanitarian service apparatus, even in some rich EU countries. Not all Salvation Army clients are impoverished by wild fires or any other natural and/compound hazards. However, such disasters generate many long-term traumatic scars which should increase the value of resources spent on investments in physical and social preparedness which saves lives.

Floods hit all nations in Europe. Their effects on humans and property have been smaller in northern regions. Most of the deaths per million inhabitants take place around River Danube, from Balkan area to Black Sea, but also the area of Slovakia and the Czech Republic have been highly affected. The studies show that persons killed in floods were mainly men, aged between 30-49 years and majority of deaths happened outdoor, on the roads. Most often people were drowned in water and/or mud when travelling by motor vehicles. Female mortality was more numerous than males in the following age cohorts < 15 years (children), 16-29 years (young adults), 65-84 (elderly) and elder than 85 years.

One specific group, which is vulnerable to both fires and floods are refugees and migrants who are not familiar with European climate, rescue systems or language, and who oftentimes cross the EU borders without prior permission from the governing authorities. In some specific areas in Europe, the numbers of 65-year-old people exceed 45 % of the population. Because this age group might be in higher danger of life loss from fires and floods, it is important to devise rescue and relief measures which address these people's susceptibilities.

In 2015 heat waves in France caused more than 3 000 deaths alone. The Finnish studies have estimated that heat might become a severe threat to public health as the high temperature spells might become more frequent and more haphazard in future. The Estonian study indicated that relatively large proportion of all-age deaths could be attributed to low winter temperatures. The Lithuanian study concluded that in future an increased risk of heat-related mortality will exceed the reduction in risk of cold-related deaths. Hence, broader access to public health services needs to be put in place as measure protecting population against deaths from thermal stressors.

Homeless people constitute an EU-wide subpopulation who live under conditions of perpetual disaster often leading to trauma-related disorders. Individual resilience is primarily related to personal strength deriving from healthy life conditions, which allow to return to sound baseline functioning even after a

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highly adverse event. The stress-induced resilience might not protect homeless and/or rough sleepers against negative impacts of more frequent natural events nor against life risks produced by long-term atmospheric changes. Most of the homeless live in cities and towns, majority of them are men. However, growing numbers of women with young children and single young children or young adults have joined the homeless cohorts over the last decade. Family homelessness is revealed to be highly gendered, i.e., it was experienced by lone women parents and their children at very disproportionate rates.

Homeless people belong to a segment of the EU population which is highly susceptible to excess mortality caused not only by distinctive natural perils but also by ambient variability. The longer a person stays homeless the more likely he/she would suffer from cancer, cardiovascular and respiratory diseases, accidents, intoxication and/or suicide. Homeless people also experience severe poverty and oftentimes come from disadvantaged minorities, the factor that independently is associated with poor health.

Although homelessness statistics in the EU are quite sketchy, they indicate that the numbers of people sleeping rough have risen during 2013-2017 and so did their mortality attributable to atmospheric and hydrological severities, at least in the locations reviewed.

Impacts of natural disasters and atmospheric variability disproportionally place persons with disabilities and their families in life threatening situations. Persons with disabilities, who might live with their families, should be helped during evacuation and the post-disaster recovery. Disabled people are at greater risk of injury, mortality, disease, destitution and displacement when compared with general population, even in highly developed countries.

For survey in Task 3.3 it is essential to understand the regional variability between places where the respondents live and what societal or administrative factors might be linked to socio-economic fragility of large swathes of population even before a hazard strike. Therefore, the background questions should also explore the pre-hazard morbidities and poverty that might exacerbate the risk of death during or in hazard aftermath.

Due to the economic strains, the state institutions in some countries cannot secure safety net to disaster survivors. The result might be marginalization which increases the value of neighbor-fostered social and community capital. However, this solution might not help the homeless and individuals who suffer from transient life pattern – such cohorts seldom maintain closed links to community or other social groups like families, because they are socially stigmatized and oftentimes excluded.

6.3 Informant Candidates for the BuildERS Survey Study

Based on the hazards impacts reviewed, the types of clients that the Salvation Army serves across Europe and the studies documenting that atmospheric variability is associated with excessive mortality among persons highly susceptible to hazard risks, the following social groups have been designated as socially, economically and medically fragile and therefore their representatives should participate as informants in BuildERS-survey studies

1) Elderly individuals 65+ who live alone or with families but depend on social help for life-supporting resources (food, clothing, social network, transportation, medical care and medicines) or who are not able to flee the area on their own when a fire or flood erupts.

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2) Children and mentally impaired individuals who do not understand the risk of fire or floods and are devoid of social service or family protection.

3) Homeless individuals (of both genders) in all age cohorts between 18 and 75+, Homeless families with young children, young adults with families but sleeping roughly. They face increased risk of cold-related injuries. Homeless people in regions affected by fires might have also suffered from impaired perceptions of hazard dangers and/ or inability to access proper shelter and thus lost accommodation, job and family members in addition to severe material impoverishment.

4) Homeless persons with disabilities (also members of their families);

5) Homeless refugees and registered /unregistered migrants in large urban centres who have become very susceptible to weather changes, and natural and other hazards such as pluvial and fluvial floods and fire disasters.

The above designation provides a framework for high-precision sample incorporating numerous cohorts of national vulnerable subpopulations in the EU that could not be reached by traditional outreach techniques and for which the standard sampling frame does not exist. Using access to the Salvation Army's welfare service systems, and/or other humanitarian support amenities, this procedure will allow to gather data from a multitude of informant cohorts, whose life situations and hazard exposure differ broadly.

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Appendixes

Appendix 1 shows hazard cases year by year in Europe during 2015-2019, from Copernicus emergency service.
Appendix 2 lists examples showing how the damage maps and statistics can be retrieved from Copernicus emergency service for some hazard cases.
Appendix 3 presents the table on the selected hazards in BuildERS-study countries during 2015-2019.

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Appendix 1. Hazard Cases in Europe During 2015 - 2019

The following figures shows the location of all-natural hazards in Europe between 2015 and 2019 for which the satellite imaging has been ordered from the Copernicus emergency service. This does not contain all the hazards occurred, like heat waves and cold periods but instead floods, fires, earthquakes, landslides, storms and others with visible damages.

Figure 53: Legend for the Copernicus Emergency Service Maps

Figure 54: Hazards with Satellite Imaging Requested by National Contact Points in 2015
Source: Copernicus Emergency Management Service (© 2019 European Union).

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Figure 55: Hazards with Satellite Imaging Request in 2016

Source: Copernicus Emergency Management Service (© 2019 European Union).

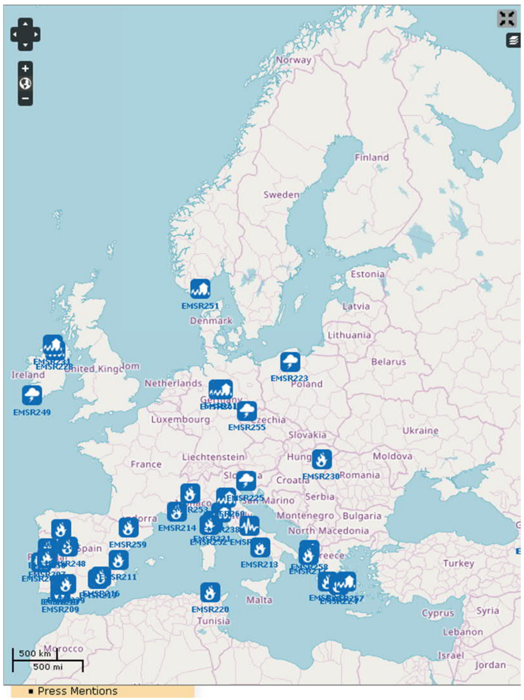

Figure 56: Hazards with Satellite Imaging Request in 2017

Source: Copernicus Emergency Management Service (© 2019 European Union)

Figure 57: Hazards with Satellite Imaging Request in 2018
Source: Copernicus Emergency Management Service (© 2019 European Union)

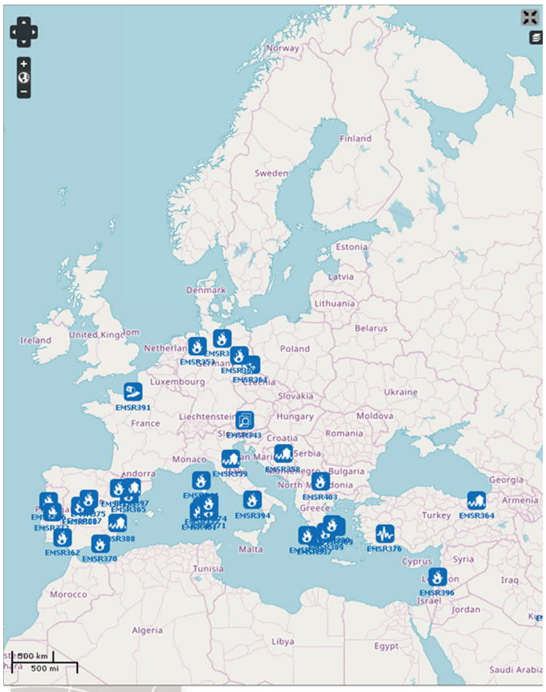

Figure 58: Hazards with Satellite Imaging Request in 2019
Source: Copernicus Emergency Management Service (© 2019 European Union)

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Appendix 2. Examples of Information from Copernicus Emergency Service

The example below refers to Amatrice earthquake in Italy in 2016. Figure below shows the locations of the earthquake discharge areas as imaged by Copernicus emergency service which hit Central Italy on August 26th, 2016. The image was requested by Italian authorities to assess the geo-squares corresponding to earthquake discharge. The next figure shows a detailed assessment of damaged buildings and roads network, and Table 1 shows statistics on the hazard damages and persons affected.

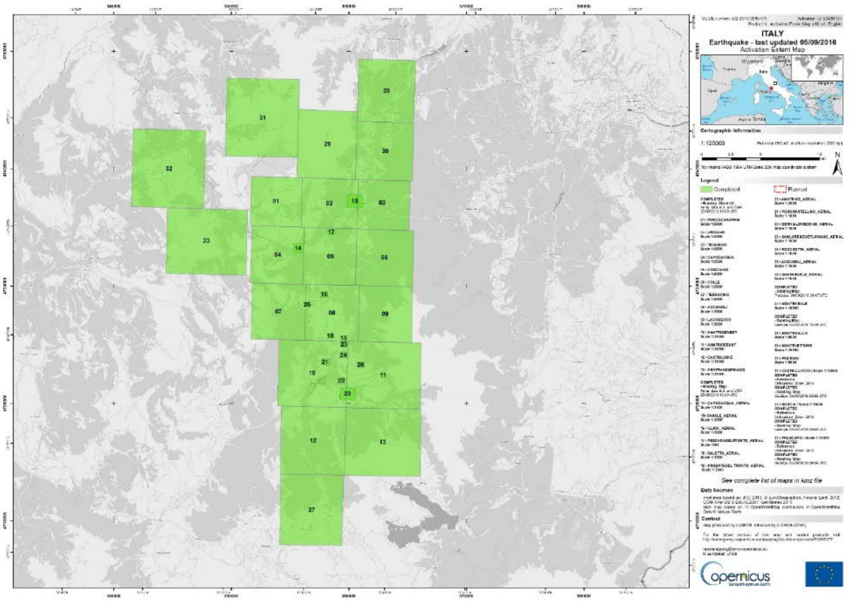

Figure 59: Impact areas of Amatrice Earthquake in 2016 in Italy
Source: Copernicus Emergency Management Service (© 2019 European Union), [EMSR177]

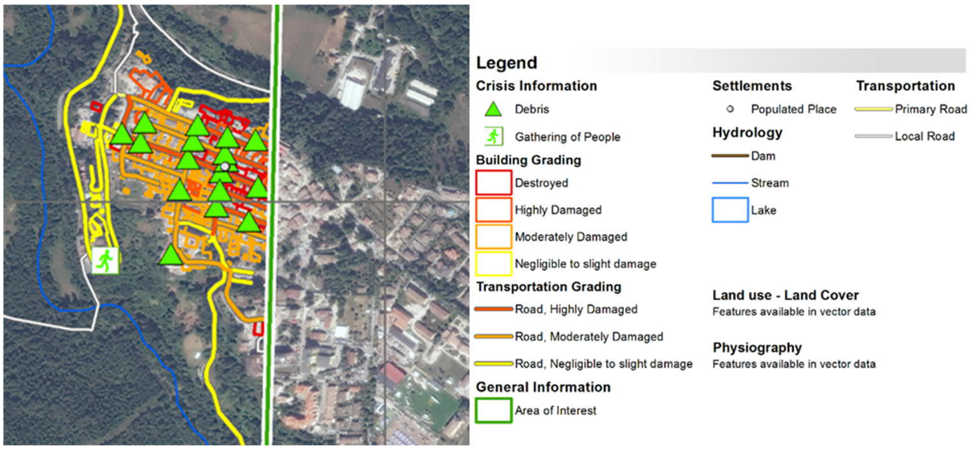

Figure 60: Extract of Layer Showing Part of Damaged Buildings and Roads during Amatrice Earthquake in August 2016 with Legend to the Right
Source: Copernicus Emergency Management Service (© 2019 European Union), [EMSR177]

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Table 11: Impact Statistics Extracted from Satellite Image

Consequences within the AOI		Unit of measurement	Destroyed	Highly damaged	Moderately damaged	Negligible to slight damage	Total affected	Total in AOI
Gathering of people		No.						1
Estimated population		No. of inhabitants					290	1038
Settlements	Residential	No.	50	50	142	20	262	1645
	Agriculture	No.	0	0	0	0	0	16
	Cemetery	No.	0	0	0	0	0	68
	Commercial	No.	0	0	0	0	0	1
	Industrial	No.	0	0	0	0	0	21
	Medical	No.	0	5	0	2	7	7
	Multi-functional	No.	0	0	0	0	0	31
	Religious	No.	3	0	4	0	7	7
Transportation	Primary roads	km	0.0	0.3	0.0	0.9	1.2	22
	Local roads	km	0.0	0.7	1.1	1.2	3.0	90.5
Land use	Cropland	ha	0	0	0	0	0	1615.3
	Grassland	ha	0	0	0	0	0	14.5
	Woodland	ha	0	0	0	0	0	1586.3

Source: Copernicus Emergency Management Service (© 2019 European Union), [EMSR177]

It is noteworthy that satellite observations retrieval has accessed the GIS database to calculate the number of people located in area of interest (AOI) which were enumerated to be 1,038 persons out of which 290 were affected by the earthquake at the time the picture of this event was taken.

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Appendix 3. Table of selected hazards in BuildERS-study countries between 2015-2019

Table 12: Hazard case table in BuildERS target countries between 2015-2019

Hazard type	Country	Discharge area or link to discharge area delineation	Date	Mortality, Injured and Affected, or Satellite imaging request	Source
Storm Snow	Austria	Heavy snowfall in Austria	7-18.1.2019	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR343
Storm	Austria	Wind Storm in the South of Austria	28.10.2018	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR340
Flood	Belgium	Floods in Limburg Province, Belgium	2.6.2016	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR167
Storm	Belgium	Belgium, Brussels	4-5.6.2019	5 injured	https://www.vrt.be/vrtnws/nl/2019/06/04/code-oranje-deze-middag-zwoel-en-onweer/
Storm	Belgium, Germany, Netherlands	North-West Europe	18.1.2018	9 deaths	https://www.theguardian.com/world/2018/jan/18/amsterdam-schiphol-flights-storm-chaos-europe
Heatwave	Belgium	Belgium, Brussels 39°	19-26.7.2019	1 death	https://www.brusselstimes.com/all-news/belgium-all-news/61488/belgium-sees-first-death-as-a-result-of-record-heat-wave/
Heatwave	Belgium	Belgium	19-25.06.2017	235 deaths (estimate based on normal condition statistics)	http://www.flanderstoday.eu/current-affairs/more-deaths-during-heatwave-june
Heatwave	Belgium	Brussels	2015	na	https://www.emdat.be/sites/default/files/maps_created_2017/Heatwave_occurrence_BEL_georef.jpg
Attack	Belgium	Brussels	22.3.2016	35 killed 340 injured	https://en.wikipedia.org/wiki/2016_Brussels_bombings
Heatwave	Estonia	Estonia, including Tallinn >30°	5-8.7.2019	na	https://www.ilmateenistus.ee/?lang=en
Flood Thunderstorm	Estonia	Tallinn	17.8.2017	na	https://www.ilmateenistus.ee/?lang=en
Flood Heavy rain	Estonia	Tallinn	10.7.2016	na	https://www.ilmateenistus.ee/?lang=en
Storm Winter	Finland	Southern Finland	19.12.2019	32 000 electricity cut-off	https://www.iltalehti.fi/kotimaa/a/fcb5c1e4-78ae-44a6-9693-a9f11f96df47
Wildfire	Finland	Pyhäranta, Varsinais-Suomi	July 2018	100 ha forest burnt, evacuations	https://yle.fi/uutiset/3-10314168
Storm Winter	Finland	Western, Central, Eastern Finland, Ahvenanmaa (Aapeli)	2.1.2019	1 death 120 000 electricity cutoff	https://yle.fi/uutiset/3-10578072

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Hazard type	Country	Discharge area or link to discharge area delineation	Date	Mortality, Injured and Affected, or Satellite imaging request	Source
Attack	Finland	Turku Market square	18.8.2017	2 deaths, 8 injuries	https://turvallisuustutkinta.fi/material/attachments/otkes/tutkintaselostukset/en/muutonnettomuudet/2017/oNRjHqmjf/P2017-01_Turku_EN.pdf
Drinking water	Finland	Nousiainen	28.1.2018	130 stomach illnesses	https://yle.fi/uutiset/osasto/news/water_contamination_warning_for_residents_of_southwest_finland_town/10045455
Heatwave	Finland	Finland	July. August 2018 (24 days)	380 deaths (estimate based on statistics from normal conditions)	https://thl.fi/en/web/thlfi-en/-/last-summer-s-heat-wave-increased-the-mortality-of-older-people-prepare-for-hot-weather-in-time
Storm	Finland	South of Hanko - Lahti - Kouvola - Vaalimaa (Kiira)	12.8.2017	50 000 electricity cut-off	https://ilmatieteenlaitos.fi/tiedote/400025196 and https://fi.wikipedia.org/wiki/Kiira-rajuilma
Storm Winter	Finland	Juupajoki, Häme, Pirkanmaa, Keski-Suomi	21.11.2015	45 000 electricity cut-off	https://yle.fi/uutiset/3-8473134
Flood	Finland, Sweden	Floods in Finland	17.5.2018	Sewage to river Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR284
Flood	France	Flood in Alpes-Maritimes, France	3.10.2020	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR467
Flood	France	Flood in South West of France	10.5.2020	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR437
Wildfire	France	Forest Fire in Corsica, France	8.2.2020	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR426
Flood	France	Flood in Occitanie, France	22.1.2020	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR421
Flood	France	Flood in Landes, France	13.12.2019	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR416
Flood	France	Flood in South East France	23.11.2019	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR411
Industrial accident	France	Industrial Accident in Rouen, France	26.9.2019	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR391
Wildfire	France	Forest fire in Corsica, France	24.2.2019	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR344
Flood	France	Floods in Aude, France	15.10.2018	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR324
Attack	France	Ile-de-France	7-9.1.2015	20 killed 22 injured	https://en.wikipedia.org/wiki/January_2015_%C3%8Ele-de-France_attacks
Attack	France	Paris	13.11.2015	138 killed 413 injured	https://en.wikipedia.org/wiki/November_2015_Paris_attacks
Attack	France	Nice	14.7.2016	87 killed 434 injured	https://en.wikipedia.org/wiki/2016_Nice_truck_attack

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Hazard type	Country	Discharge area or link to discharge area delineation	Date	Mortality, Injured and Affected, or Satellite imaging request	Source
Flood	France	Floods in Northern France	22.1.2018	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR265
Wildfire	France	Forest fire in Corsica, France	4.1.2018	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR263
Wildfire	France	Wildfire in Corsica	23.10.2017	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR252
Storm	France	Hurricane Irma in Antilles Islands	6.9.2017	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR232
Wildfire	France	Forest fire in Corsica, France	11.8.2017	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR221
Wildfire	France	Forest Fires in Southern France	24.7.2017	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR214
Flood	France	Floods in Southern France	13.10.2016	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR188
Flood	France	Flood in Loiret	30.5.2016	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR165
Flood	France	Floods in Corsica, France	1.10.2015	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR139
Chemical explosion	Germany	Ludwigshafen	17.10.2016	5 deaths, about 10 injured	https://www.dw.com/en/fourth-person-dies-after-basf-chemical-plant-blast-in-ludwigshafen/a-3619888
Flood	Germany	Floods in Lower Saxony, Germany	14.12.2017	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR261
Flood	Germany	Flood in Braunschweig "Julihochwasser"	26.7.2017	Millions of Euros property damage Imaging request	https://www.braunschweig.de/leben/umwelt_naturschutz/wasser/hochwasserschutz.php
Flood	Germany	Floods in Bavaria, Rottal-Inn, Passau, Triftern	1.6.2016	10 000 houses without electricity Imaging request	https://www.pnp.de/themen/2016/hochwasser_2016/?em_index_page=18
Landslide	Germany	Landslides in Saxony, Germany	9.4.2019	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR361
Storm	Germany	Wind Storm Friederike in Central West Germany	18.1.2018	8 death, affected millions of people Imaging request	https://www.n-tv.de/panorama/So-wuetete-Friederike-durch-Deutschland-article20239933.html
Storm	Germany	Wind Storm in Saxony, Germany	29.10.2017	4 deaths, affected millions of people Imaging request	https://www.sueddeutsche.de/panorama/naturkatastrophen-die-bilanz-von-sturm-herwart-1.3730440

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Hazard type	Country	Discharge area or link to discharge area delineation	Date	Mortality, Injured and Affected, or Satellite imaging request	Source
Storm	Germany	Hannover, Hamburg, Berlin (Storm Xavier)	6.10.2017	7 deaths in Germany	https://www.bz-berlin.de/berlin/so-wuetete-sturm-xavier-in-berlin
Wildfire	Germany	Forest fire in Mecklenburg-Western Pomerania	July 2019	650 people directly affected, thousands of others indirectly affected by fine-dust	https://www.spiegel.de/panorama/luebtheen-waldbrand-in-mecklenburg-vorpommern-der-ueberblick-a-1275251.html
Wildfire	Germany	Forest Fire in Brandenburg, Germany	3.6.2019	Forest damages Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR363
Wildfire	Germany	Wildfire in Lower Saxony, Germany	22.4.2019	No casualties Imaging request	https://www.thelocal.de/20190423/wildfires-rage-during-germanys-spring-heatwave
Wildfire	Germany	Fire in Brandenburg, Germany	21.9.2018	Forest damages Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR315
Wildfire	Germany	Brandenburg	25.6.2019	Forest damages	https://www.faz.net/aktuell/gesellschaft/feuer-in-brandenburg-weitet-sich-aus-16253426.html
Wildfire	Germany	Jüterborg,	3.6.2019	Forest damages	https://www.rbb24.de/panorama/beitrag/2019/06/wetter-hitze-waldbraende-jueterbog-hitzewarnung-.html
Wildfire	Germany	Forest Fire in Jüterborg, Germany	23.8.2018	Forest damages Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR307
Wildfire	Germany	Wittenberg	11.8.2018	Forest damages	https://www.volksstimme.de/sachsen-anhalt/waldbrand-80-hektar-brennen-bei-wittenberg
Wildfire	Germany	Forest fire in Saxony-Anhalt, Germany	4.7.2018	Forest damages Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR295
Attack	Germany	Berlin	19.12.2016	12 killed 56 injured	https://en.wikipedia.org/wiki/2016_Berlin_truck_attack
Flood	Greece	Flood in Western Greece	12.1.2019	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR337
Flood	Greece	Flood in North Eastern Greece	28.6.2018	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR292
Flood	Greece	Floods west of Athens, Greece	27.6.2018	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR294

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Hazard type	Country	Discharge area or link to discharge area delineation	Date	Mortality, Injured and Affected, or Satellite imaging request	Source
Flood	Greece	Flood in Thrace, Greece	27.3.2018	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR277
Flood	Greece	Floods in Central Greece	24.2.2018	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR271
Flood	Greece	Flood in Attika, Greece	15.11.2017	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR257
Flood	Greece	Flood in Greece	30.3.2015	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR122
Flood	Greece	Flood in Greece	1.2.2015	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR117
Wildfire	Greece	Fires on Thasos Island	10.9.2016	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR180
Wildfire	Greece	Forest fire in Zakynthos Island, Greece	15.9.2019	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR390
Wildfire	Greece	Forest fire in Loutraki area, Greece	14.9.2019	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR389
Wildfire	Greece	Forest fire in Evia Island, Greece	13.8.2019	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR380
Wildfire	Greece	Forest Fire in Evia Island, Greece	4.7.2019	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR369
Wildfire	Greece	Forest Fire in Sithonia, Greece	25.10.2018	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR331
Wildfire	Greece	Forest Fire in Evia Island, Greece	12.8.2018	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR306
Wildfire	Greece	Forest Fire in Western Achaia, Greece	11.9.2017	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR242
Wildfire	Greece	Forest fire in Zakynthos Island and Kalamos	11.8.2017	State of Emergency	https://emergency.copernicus.eu/mapping/list-of-components/EMSR224
Wildfire Heatwave	Greece	Forest Fires in Attika, Greece	23.7.2018	91 deaths Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR300
Wildfire	Hungary	Fire in Hungary, Kiskunsag National Park, a Natura 2000 protected area	24.7.2015	Imaging request	https://www.researchgate.net/publication/326175866_A_2015-OS_BOCSAI-KASKANTYUI_ERDOTUZ_TERINFORMATIKAI_ALAPU_FELMERESE_ES_TOVABBI_TERMESZETVEDELMI_KEZELESE
Wildfire	Hungary	Forest Fire in Nagyivan, Hungary, Hortobágy National Park	3.8.2017	400 animals	https://www.dehir.hu/hajdu-bihar/hortobagyi-tuz-honvedsegi-helikopterek-is-reszt-vesznek-az-oltasban/2017/08/04/
Flood	Ireland	Flood in North Western Ireland	22.8.2017	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR231
Flood	Ireland	Floods in Roscommon II	4.3.2016	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR156

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Hazard type	Country	Discharge area or link to discharge area delineation	Date	Mortality, Injured and Affected, or Satellite imaging request	Source
Flood	Ireland	Floods in Roscommon	5.2.2016	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR154
Flood	Ireland	Flood in Ireland	4.12.2015	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR149
Storm	Ireland	Hurricane Ophelia in Ireland	16.10.2017	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR249
Flood	Italy	Flood in the North East Italy Venice	12.11. 2019	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR409
Earthquake	Italy	Earthquake in Central Italy Umbria and Marche	26.10.2016	Affected > 22 000	https://emergency.copernicus.eu/mapping/list-of-components/EMSR190
Earthquake	Italy	Earthquake in Central Italy Amatrice Lazio Abruzza Umbrio	24.8.2016	296 deaths, affected around 5000 Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR177
Earthquake Heavy snowfalls	Italy	Earthquake in Central Italy Abruzzo	18.1.2017	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR194
Flood	Italy	Flood in the North of Italy	11.5.2019	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR359
Flood	Italy	Flood in Veneto, Italy	30.10.2018	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR332
Flood	Italy	Flood in southern Sardinia, Italy	10.10.2018	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR329
Flood	Italy	Flood in Northern Italy	12.12.2017	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR260
Flood	Italy	Flood in Tuscany, Italy	10.9.2017	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR238
Flood	Italy	Floods in Northern Italy	24.11.2016	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR192
Flood	Italy	Flooding and landslides in Campania, Italy	14.10.2015	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR141
Flood	Italy	Flooding and landslides in Emilia Romagna	14.9.2015	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR138
Flood Landslide	Italy	Flood in Sicily, Italy	2.11.2018	12 deaths Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR333
Flood Landslide	Italy	Flood in Sicily, Italy	18.10.2018	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR330
Wildfire	Italy	Forest Fires in Sardinia	4.7.2016	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR171

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Hazard type	Country	Discharge area or link to discharge area delineation	Date	Mortality, Injured and Affected, or Satellite imaging request	Source
Wildfire	Italy	Fires in Sicily	16.6.2016	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR169
Volcanic eruption	Italy	Volcanic eruption Mount Etna, Italy	3.12.2015	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR148
Phytosanitary	Italy	Phytosanitary emergency in Italy	10.4.2015	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR124
Storm	Italy	Wind Storm in north-east of Italy	26-27.10.2018	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR334
Storm	Italy	Storm in Friuli, Italy	10.8.2017	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR225
Wildfire	Italy	Forest fire in Sardinia, Italy	22.10.2019	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR401
Wildfire	Italy	Forest fire in Campania, Italy	20.9.2019	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR394
Wildfire	Italy	Wildfire in Sardinia, Italy	6.8.2019	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR377
Wildfire	Italy	Fire in Sardinia, Italy	28.7.2019	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR374
Wildfire	Italy	Fire in Sardinia, Italy	13.7.2019	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR371
Wildfire	Italy	Forest Fire in Tuscany, Italy	24.9.2018	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR316
Wildfire	Italy	Forest fire in Piemonte, Italy	27.10.2017	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR253
Wildfire	Italy	Forest Fire in Southern Italy	11.7.2017	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR213
Volcanic eruption	Italy	Etna Volcano eruption in Sicily, Italy	24.12.2018	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR336
Explosion	Italy	Sicily firework factory explosion	20.11.2019	5 deaths, several injured	https://www.itv.com/news/2019-11-21/71-year-old-woman-among-five-dead-in-italian-fireworks-factory-explosion/
Flood	Norway	Floods in Norway	10.5.2018	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR283
Flood	Norway	Floods in Norway	21.10.2017	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR251
Heatwave	Norway	Finnmark Oslo area	July- August 2018	40 forest fires	https://en.wikipedia.org/wiki/2018_European_heat_wave
Wildfire	Portugal	Forest fire in Castelo Branco, Portugal	13.9.2020	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR463
Wildfire	Portugal	Forest Fire in Viseu, Portugal	7.9.2020	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR462
Wildfire	Portugal	Forest fire in Castelo Branco, Portugal	25.7.2020	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR448

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Hazard type	Country	Discharge area or link to discharge area delineation	Date	Mortality, Injured and Affected, or Satellite imaging request	Source
Wildfire	Portugal	Fire in Algarve, Portugal	19.6.2020	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR443
Flood	Portugal	Flood in Portugal	19.12.2019	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR417
Storm	Portugal	Tropical Cyclone in Flores Island, Portugal	2.10.2019	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR395
Wildfire	Portugal	Forest fire in Aveiro District, Portugal	5.9.2019	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR386
Wildfire	Portugal	Fire in Castelo Branco, Portugal	20.7.2019	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR372
Wildfire	Portugal	Forest Fire in Faro, Portugal	3.8.2018	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR303
Wildfire	Portugal	Forest fire Portugal	15.10.2017	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR250
Wildfire	Portugal	Forest fires in Leiria District, Portugal	17.6.2017	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR207
Humanitarian	Portugal	Fátima 100th Anniversary	13.5.2017	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR204
Forest fire	Portugal	Forest Fire in Madeira Island	8.8.2016	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR175
Flood	Romania	Flood in Romania	30.6.2018	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR293
Flood	Romania	Floods in Romania	12.10.2016	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR187
Floods	Romania	Half of Romania's counties, incl. Bucharest	June 2019	260 evacuated	http://floodlist.com/tag/romania
Nightclub fire	Romania	Bucharest	30.10.2015	27 deaths, 184 injured	https://www.reuters.com/article/us-romania-blast/romanian-nightclub-fire-leaves-27-dead-184-injured-idUSKCN0SO2UG20151031
Storm	Romania	Timisoara	18.9.2017	8 deaths 67 injured	https://www.bbc.com/news/world-europe-41302569
Attack	Spain	Barcelona	17-18.8.2017	24 killed 152 injured	https://en.wikipedia.org/wiki/2017_Barcelona_attacks
Wildfire	Spain	Forest Fire in Cabezuela Del Valle, Spain	27.8.2020	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR458
Wildfire	Spain	Forest Fire in Almonaster La Real, Spain	27.8.2020	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR457
Wildfire	Spain	Forest fire in Santa Ursula (Tenerife),...	23.2.2020	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR430

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Hazard type	Country	Discharge area or link to discharge area delineation	Date	Mortality, Injured and Affected, or Satellite imaging request	Source
Wildfire	Spain	Forest Fire in Canary Islands, Spain	22.2.2020	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR428
Other	Spain	Collapse of a dumping site, Basque Country...	6.2.2020	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR425
Flood	Spain	Floods in Girona and Mediterranean coast,...	23.1.2020	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR422
Flood	Spain	Flood in Segre River Basin, Spain	22.10.2019	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR397
Flood	Spain	Flood in the Southeast of Spain	11.9.2019	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR388
Wildfire	Spain	Forest fire in Valleseco, Gran Canaria,...	17.8.2019	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR382
Wildfire	Spain	Forest fire in Cazadores, Spain	12.8.2019	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR381
Wildfire	Spain	Forest fire in Artenara, Spain	10.8.2019	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR379
Wildfire	Spain	Forest fire in Segovia, Spain	4.8.2019	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR375
Wildfire	Spain	Fires in Zaragoza, Spain	23.7.2019	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR373
Wildfire	Spain	Forest fire in Sierra de Gador, Spain	13.7.2019	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR370
Wildfire	Spain	Forest Fire in Castile and León, Spain	28.6.2019	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR368
Wildfire	Spain	Wildfire in Community of Madrid, Spain	28.6.2019	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR367
Wildfire	Spain	Fire in Torre de l'Espanyol, Spain	26.6.2019	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR365
Wildfire	Spain	Forest Fire in Andalusia, Spain	1.6.2019	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR362
Wildfire	Spain	Forest Fire in Canary Islands, Spain	15.5.2019	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR360
Flood	Spain	Flash Flood in Andalusia, Spain	21.10.2018	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR3627
Flood	Spain	Flash Flood in Malaga, Spain	21.10.2018	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR326
Flood	Spain	Flood in Balearic Island, Spain	10.10.2018	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR323

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Hazard type	Country	Discharge area or link to discharge area delineation	Date	Mortality, Injured and Affected, or Satellite imaging request	Source
Wildfire	Spain	Forest Fire in Valencia, Spain	6.8.2018	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR305
Wildfire	Spain	Wildfire in Andalucia, Spain	2.8.2018	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR302
Wildfire	Spain	Forest fire NW Spain	12.5.2018	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR288
Flood	Spain	Flood in the Ebro river basin, Spain	12.4.2018	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR279
Wildfire	Spain	Forest Fire in Tenerife, Spain	8.4.2018	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR278
Wildfire	Spain	Forest Fire in Aragon	4.12.2017	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR259
Wildfire	Spain	Forest Fires in Castilla y León region,...	15.10.2017	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR254
Wildfire	Spain	Forest Fires in Castilla y León region,...	29.7.2017	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR248
Wildfire	Spain	Forest fire in Andalusia, Spain	9.9.2017	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR239
Wildfire	Spain	Forest fire in Andalusia, Spain	9.9.2017	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR237
Wildfire	Spain	Forest fire in Leon, Spain	22.8.2017	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR227
Wildfire	Spain	Wildfire in Jaen	3.8.2017	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR219
Wildfire	Spain	Forest fire in Natural Reserve of Calar	27.7.2017	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR216
Wildfire	Spain	Forest Fires in Castellón Province	28.6.2017	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR211
Wildfire	Spain	Forest Fires in Rio Tinto, Huelva Province	3.7.2017	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR210
Wildfire	Spain	Forest Fires in Doñana, Huelva Province	24.6.2017	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR209
Forest fire Wildfire	Spain	Forest Fire in La Palma Island	3.8.2016	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR173
Other	Spain	Flash Flood in Spain	7.9.2015	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR135
Forest fire Wildfire	Spain	Forest fire in Cáceres, Spain	6.8.2015	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR132
Forest fire Wildfire.	Spain	Forest fire in Castellón, Spain	7.7.2015	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR131
Forest fire Wildfire.	Spain	Fires in Spain	5.7.2015	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR127

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Hazard type	Country	Discharge area or link to discharge area delineation	Date	Mortality, Injured and Affected, or Satellite imaging request	Source
Flood	Spain	Flood in Spain	27.2.2015	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR120
Heatwave	Sweden	Sweden	July 2018	700 deaths (estimate based on normal conditions statistics)	https://www.folkhalsomyndigheten.se/nyheter-och-press/nyhetsarkiv/2018/december/okad-dodlighet-under-sommarens-varmebolja/
Wildfire	Sweden	Forest Fire in Central Sweden	16.7.2018	Evacuations of people (~100) and livestock Imaging request	https://www.regeringen.se/4906d2/contentassets/8a43cbc3286c4eb39be8b347ce78da16/skogsbranderna-sommaren-2018-sou-2019-7.pdf
Wildfire	Sweden	Forest fire in Sweden	3.6.2018	Evacuations of people and livestock Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR290
Storm	Sweden	Svealand, Gotland (Alfrida)	01-02.01.2019	100 000 households without electricity Forest damages 0.5 M m³	https://www.skogssverige.se/skog/stormfallning/kanda-stormar
Storm	Sweden	Helsingborg, Halmstad, Skåne, Kronobergs, Blekinge och södra delen av Hallands län (Gorm)	29-30.11.2015	Forets damages 2-2.5 M m³	https://www.skogssverige.se/skog/stormfallning/kanda-stormar
Storm	Sweden	Södra Sverige, Götaland, Jönköping län (Egon)	10-11.01.2015	70 000 households without electricity Forest damages 2.5-3 M m³	https://www.skogssverige.se/skog/stormfallning/kanda-stormar
Refugee crisis	Sweden	Sweden	2015	156 110 first time applicants (16 016 applic./1 M inhabitants)	https://ec.europa.eu/eurostat/documents/2995521/7203832/3-04032016-AP-EN.pdf/790eba01-381c-4163-bcd2-a54959b99ed6
Heatwave	UK	London	25.7.2019	na	https://www.thesun.co.uk/news/9580011/uk-weather-forecast-today-heatwave-2019-hottest-day/

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Hazard type	Country	Discharge area or link to discharge area delineation	Date	Mortality, Injured and Affected, or Satellite imaging request	Source
Flood	UK	Flooding in Northern Ireland, United Kingdom	23.8.2017	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR228
Flood	UK	Flood in Northern Ireland	11.1.2016	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR151
Flood	UK	Flood in England	27.12.2015	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR150
Flood	UK	Flood in Cumbria	5.12.2015	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR147
Wildfire	UK	Wildfire in England	24.6.2018	Imaging request	https://emergency.copernicus.eu/mapping/list-of-components/EMSR291
Wildfire	UK	Wildfires in Northern Scotland	15.4.2018	Imaging request	

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Response to Review 2 Comments on D3.1

Review Comments on D3.1	Corrections	Locations
The project failed to address the previous comments and recommendations and the revisions done are insufficient. The documents should be seriously reworked in full accordance with the current and previous review reports to avoid a definitive rejection. Almost the same information has been submitted again, but for slight changes in the order of the information, with no significant differences in methodology, logic, and conclusions. It appears	The D3.1 has been extensively reworked to make explicit the below principles that guided the attainment of its purpose. The D3.1 selection of vulnerable group/individuals for T3.2 and T3.3 studies were done through alignment of the D1.2 abstract theoretical concepts with these concepts' real-life manifestations and records of severe hazard discharge which hit Europe during 2015-2019. Consequently, the work in T3.2 and T3.3 will measure and assess the empirical formats/levels of e.g., vulnerabilities among various social groups/ cohorts of recipients of social services provided by the Salvation Army and/or other NGOs in 12 EU countries. The theoretical framework did not recommend any pre-defined "salient" operationalizations of its theoretical constructs. On the contrary, it was open to empirical validations enriching its prior substance with the new field-work-and data-derived analytical evidence. A large volume of new empirical data enlightening the cross-sectional-features of social vulnerabilities and hazard damages that disrupted the stability of the EU countries would broaden the theoretical concepts with new empirical validity. Another benefit of deeper EU-embedded real-life support for the D1.2 theoretical framework was that the data-derived results will constitute a solid evidence for recommendations of changes in the existing policies, administrative practices and the level of investments needed for reducing social vulnerability and enhancing resilience. Given the scarcity of national resources that might need to be repurposed for vulnerability reduction and enhancement of social capital through public investments, such changes cannot be based on theoretical framework alone.	Chapters 1, 2, 5 and 6

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	The choice of Salvation Army's service recipients as highly diverse population of vulnerable groups/individuals from which the survey sample will be drawn is justified by the fact that no systematic statistics of highly disadvantaged people from which a representative sampling frame could be extracted exist in Europe. The Salvation Army operates service provision facilities in 26 EU countries which yearly support over 2.5 million of needy individuals. These persons are oftentimes hard-to-reach, invisible, living on the fringes of society, and avoiding public scrutiny or scientific investigation. For these reasons, the Salvation Army as the BuildERS partner stepped in to facilitate access, safety and security for the different recipients of its humanitarian aid, and thereby enabling the researchers to identify and designate the different vulnerable subgroups and/or cohorts for the forthcoming T3.2 and T3.3 studies. A new subchapter was added (5.4) explicating the trade-offs between the effectiveness and the ethics that this work needs to respect. It substantiates the commitment to the most effective utilization of research resources for public good by exploring the life conditions of vulnerability groups who statistically are most overexposed to hazard destruction and thus, suffer from the highest risk of premature death. Channelling the public means to reduction of these cohorts' mortality will swiftly enhance the level of social capital and the communal welfare.	
The rationale behind the categorization of those in vulnerable situations keeps not being explained in the document	The rationale for the categorization of vulnerable persons to participate in the international survey relies on three criteria 1) Persons suffering from s*ocial exclusion (such as Salvation Army's clients*) 2) Spatiotemporal *proximity of hazard damage* to the Salvation Army's service facilities in 12 EU countries, and 3)	pp. 81-87 pp.15-18

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	Mortality growth among general severely vulnerable groups attributed to *atmospheric variability.*	pp.20-35 pp.58-80
Unbalanced information and explanations have been dedicated to different targets	The proportions of D3.1 space dedicated to topics, such as 1) Mapping of Hazard Impacts, 2) Disaster Mortality 3) Atmospheric Variability as Mortality Agent, and 4) Identification of Survey Informants has been evened-out.	pp.20-34 pp.35-56 pp.58-80 pp.81-86
A blend of national and local information and its application to the identified areas and targets is needed	Data on hazard discharge areas and proximity to SAL service facilities are at NUTS 3. Data on economic losses and mortality by hazard types at national/hazard/ discharge/ levels/ people killed. Percentage of populations in poverty in proximity to hazard discharges at NUTS 2. Mortality counts from fires and floods are per 1mil. inhabitants. Areas burned-in hectares. Refugees/ migrants by arrivals routes in numbers of individuals. The differences in data units and levels are caused by the lack of uniform country- statistics, and uneven geospatial dispersion of hazard damage across EU regions/countries/ locations.	
.. to narrow down the project enormous scope and clarify the approach	A narrowing down of the selection criteria was achieved through inspections of data, information on 2015-2019 hazard sites, human and material losses, and studies on vulnerability drivers. An approach for respondent sample selection among the Salvation Army's clients in order to achieve a clearer focus is presented.	pp. 20-34 pp 35-56 pp.58-80 pp.81-86
".. selection of vulnerable groups for WP4 case studies" is due to the analysis done in report, whereas it appears case studies' target selection was made before this piece of work	Case studies targets' selection was indicated in the DOW WP4 description. This mention referred to sought synergistic gains between D3.1 body of knowledge on vulnerability drivers and hazard locations and the WP4 field work in six countries addressing the different stages of crisis management.	DOW pp. 42-50

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Responses to First Review Critique Levelled at D3.1By Eija Parmes, VTT & Johanna Ludvigsen, TOI

Review Conclusion	Response	
	Addition of hazards discharge areas in France, Netherlands, Spain, Portugal, Denmark with affected population strata are posted in Appendix 3 to increase the geo-spatial coverage of the study and making its results more germane for the entire EU. The concepts of “human and social vulnerability” and “social capital” elaborated by WP1 D1.1 theoretical framework have been operationalized by providing several empirical manifestations derived from the different national and regional contexts, which would be used in WP3 Tasks 3.2 and 3.3 as well in some cases studied in WP4 for variable formulation, variable measurements and the empirically– embedded theory validation. Chapter 6 elaborating on the nexus between changing atmospheric conditions and rises in mortality and morbidity among the entire EU population, but particularly among its weakest sub-groups such as the homeless, the displaced and the individuals suffering from fragile health conditions, severe poverty and other ailments caused by the socioeconomic exclusion has been transferred to Appendix 4. It documents that seemingly innocuous long-term climate change phenomena which do not impose immediate techno-physical damage and/or lasting destruction, function as effective killers of relatively young people from socially disadvantaged groups. This source of premature deaths has not been yet sufficiently discussed in typical natural hazard impact studies. Literature supporting the latter statement is provided in D3.1. references. The locations of vulnerable groups have not been more explicitly marked on hazard maps. Instead, the SAL personnel will add the locations to the integrated maps at the later stage of the study, so that the risk of leakage of confidential data and information during data transfer between several entities is minimized.	

The selection of disadvantaged people needs to be strongly linked to the theoretical framework. As the latter is not presented yet, this report can only be meaningfully drafted, when D1.2 is finalized. The selection process needs to be strongly grounded in the theoretical framework.	See the explanation above on how the theoretical concepts of "human and social vulnerabilities" and " social capital" from the D1.2 theoretical frameworks have been operationalized by providing several on-the ground manifestations which might serve as guidance for T3.2 and T3.3 variable formulation and variable measurement through survey interviews.	
"D3.1 has critically reviewed an array of scientific literature to create a knowledge base for understanding of how natural hazards did alleviate the risks of morbidity and mortality for the entire European population". This sentence is unclear, please explain.	Replaced with elevated	Pg. 4
Category 11. "People who work predominantly outdoor and whose health conditions bear the negative marks of elongated exposure to different types of weather and who also witnessed severe hazards (e.g., floods, fires and / or combinations thereof) with high death toll and material destructions)". It is not clear and has not appeared in previous documents, please clarify.	Outdoors working category of people has been removed	Pg. 4
To analyse and identify potential barriers or constraints people encounter and prevent them from entering "the	The hazards that affect especially the category in question, has been added	

normal" or provoking them to remain vulnerable would help to clarify certain categories (missing in the rationale).		
No category related to tourists has been found in this deliverable (pg. 4). The targets are not systematized an aligned with the case studies proposed in web site, where tourists appear several times, while not being considered as target in this deliverable. Please, clarify	D3.1. covers only European hazards, and tourist evacuation from earthquake afflicted areas will be explored by Indonesian case study in WP5 Tasks T4.7. Tourists were not visibly exposed to natural hazards during the period studied in the literature reviewed. References to WP1, D1.2 and 1.3, and WP4 case studies have been added	Pg. 4
Term hazard resilience appears for the first time. Please clarify	It is changed to resilience towards hazards. Those two words are defined in page	Pg. 13
Point 1 about "delineating the most vulnerable" implies spatiality and spatial location as a specific dimension of vulnerability but this is not considered in the 11 categories proposed (pg. 4). Please, clarify how these 11 categories have been decided and how they are related with future case studies	delineating is replaced with defining. This term relates to how to pinpoint the location of the vulnerable groups on the hazard maps. We decided not to add this information at this phase, but SAL personnel will transfer the maps so that they can add the vulnerable groups locations or shelters to the final maps in D3.4 and preserve confidence. The relation of the categories to Task 3.3 interviews and WP 4 use cases has been clarified	Pg. 13
"Predominantly, recruitment sites will be		Pg. 24

cities and urban areas with population over 50,000 inhabitants in the BuildERS project consortium countries with Salvation Army's, Caritas and/ or Red Cross welfare providing apparatus.". In previous work spatial location was mentioned but not addressed specifically - in national data analysis, etc. so as to better understand vulnerability as for local action - Urban reality (over 50.000) requires specific knowledge (built environment and urban governance to cite some examples) as for response adequacy. The decision of analyzing urban settings over 50.000 could bias the results of the project. Reasons to take this decision should be clarified. Different spatial realities (size, scale, environment) are needed to be understood and used to achieve practical steps forward. There are not practical conclusions about rural urban linkages or differences between built environments detailed in the researching, when some of the organizational dimensions of resilience and resilience management are totally determined by these spatial, governance and geographical characteristics.	The practical requirement of SAL cities (in some cases Caritas and Red Cross) replaces this requirement which is removed. However, the SAL functionaries' will try to interview a broad specter of their clients at different social service stations located in different places, in different regions in fourteen countries	

At page 24 it is reported:" Predominantly, recruitment sites will be cities and urban areas with population over 50,000 inhabitants in the BuildERS project consortium countries with Salvation Army's, Caritas and/or Red Cross welfare providing apparatus.". It happens that the Salvation Army has only a few premises in some countries, So the links between the responder, the interviewer, their locations and the perimeter of hazard discharge are crucial to record different experiences and to ensure results consistency. This situation could constitute a bias for the project outcomes, if not properly managed: the project will have to address it as early as possible. Section 4.2.2 Information Sources on Hazard Cases. "6. Local partners and authorities provided detailed information on hazard from national databases, emergency management services and newspapers". (pg. 26). This source is unclear, is it local or national? It is important, because it is related with one of the risks of the project (relation between local responders and national institutions). Brussels, Tallinn and Oslo are cities selected for survey pilots, but table related to	J:In a manual for interviews in D3.2 this issue discussed It is partners and national authorities. Local was a bug to state the country's partner.	Pg. 29

Oslo has not been submitted, it is not possible to assess whether this city is adequate for the survey. Figure 10. If Roma is not affected by the Hazards proposed, why it is in the sample? (table 2). It is unclear what kind of conclusions could be derived from the work in this city. More overlapping maps are needed to evaluate whether these cities in table 2 are the adequate to work in, apart from the work of stakeholders related. Please, amend Fig 26 and 27 are not so detailed so as to reach any conclusion – 20/30% share is spread all over the map of Europe and wild fires are used to being declared out of urban settings- : “Comparison of data in figures 24 and 25 indicates that the highest numbers of fatalities attributed to wildfires in Spain, Portugal, Greece and Italy’s during 1976 - 2016 occurred in regions where thirty percent or higher share of population were at the risk of poverty and social exclusion in 2017”. Please, provide more information. Page 61: “Another hypothesis posing that the homeless people in regions	Oslo table is being added The result will be the intersection of the layers. All candidates are shown in the map, and only those will be selected whose selection apply to the criteria specified at beginning of chapter 4. The philosophy behind is to capture all possible information, because some people who left might stay at other locations and be interviewed there.	

affected by fires might have suffered more fatalities than the population at large due to impaired perceptions of hazard dangers and/ or inability to access proper shelter is also worth to be verified empirically by the T3.2 and T3.3 survey studies". Please, clarify if the texts refer to wild / industrial or urban fires, and how these fires are related to homeless	We do not know yet - as stated in the text – it is a hypothesis which is worthy to be studied empirically by WP3 T3.2 and T3.3 international survey. The survey might provide clear-cut answers as to what types of fire hazards appeared the most dangerous (in terms of fatalities inflicted) to homeless people.	
At page 61, the reference to "Figure no. 33" refers instead to Figure 34. Please amend	Corrected.	
Page 64: "Majority of flood-related mortality cases in the Mediterranean region found place in 6 national regions: Catania (Spain),(…)". Please, Catania to be replaced by Catalonia	Has been corrected.	Pg. 64
The rationale behind the categorization of those in vulnerable situations is not explained in the document. Unbalance information and explanations have been dedicated to different targets. Blend of national and urban information, and application of this combination to the sample cities selected for work and surveys is needed in order to narrow down the enormous scope of the project and clarify the approach. It is very difficult to envision how surveys and	The coping abilities of vulnerable groups who experienced at least one hazards (specified in the questionnaire) will be explored in Task 3.2 and T3.3 of WP3. Further, WP 4 will perform six cases studies which (among others) will assess how to help vulnerable people with special needs for mental, somatic, physical and economic support who are exposed to man-made emergencies, and how to prioritize highly fragile individuals under evacuation. Several innovations will be produced which will inform the first respondent operational practice and provide evidence-based documentation for adjustment of civil and social protection policies. Results inform how to reduce the numbers of casualties and human injuries from severe emergencies by making rescue, relief,	

case studies are going to build knowledge and what kind of lessons learnt could be derived from them when the rationale proposed in this document is not clear.	aid and evacuation operations more needs-driven and incorporating the topographic and topologic features of disaster impact territories. The selection process for the interviewees is clarified in beginning of chapter 4. The procedures for domiciling the respondent whereabouts and selections will be done by analytical work under WP3 T3.2 and T3.3 based on the results from international survey studies in fourteen EU countries The Salvation Army's social protection and aid apparatus is serving people from 130 different nations, regions and jurisdictions, from different population strata and with different demographics and ethnicities. The decision on drawing the convenience sample of survey participants was based on the BuildERS project objective to explore and assess how severely vulnerable people did cope with the current Covid-19 pandemic and with natural and man-made hazards. This prerequisites that informants have been exposed to Corona 19 pandemic and experienced at least one of natural and/or anthropogenic hazards which have stricken Europe over 2015-2019. These results will not pertain to the entire EU populations, but to some human strata who suffer from deficiency in safety, security, and medical protection. Survey-answers will thus inform where hazard encounters happened and what aid the survivors received (if any), and who were the rescuers and/or post-event assistance providing agents. Based on the detail documentation the derived policy suggestions will be stratified by responsibility domains of public and private institutions operating at European, national, regional and municipal levels.	
No examples related to cyber-attacks and / or terrorist attacks have been found in Annex 3. Please,	Too few attacks.	

explain why, when case studies area addressing these issues. Protection/ prevention against recurrence of the Estonian case of cyber-attack from 2008 when the country's public web sites were jammed by external criminals and denial of service disrupted the functionality of the entire national administration system will be studied in WP4 Task 4.4		
It is recommended to count on intermediaries of those in vulnerable situations only when it is not possible to interact directly with them. The deliverable should be revised to include previous comments.	WP3 T3.3 and T3.3 international surveys will also poll the Salvation Army and Red Cross staff and functionaries in cases when their clients are inaccessible (for technical reasons) or incapable of providing answers to questionnaire or when ethical restrictions preclude direct contacts with informants. Functionaries and staff will also be surveyed on issues related to how the Corona-19 pandemic affected their clients and what social and medical policy implications client experience might provide.	
Tables and graphics of temperatures in pages 38-40 are not addressing the sample cities. It is unclear why so much information is dedicated to this specific urban hazard (de-linked of case studies proposed in the web site). Please, take into consideration heatwaves and Heat Island related effects make this hazard more harmful In cities, but not only cities are affected. And in cities it is not only homeless who suffer, but also children,	The whole chapter was moved to Appendix 4 The reason why some D3.1 space was devoted to severely vulnerable homeless people derives from fact that these cohorts suffer from high rates of premature deaths - their life expectancy seldom exceeds 45 years. That why they deserve not only special attention but also, special-need-driven aid. Barcelona and other places like Helsinki and Turku in Finland provide good examples of how homelessness might be reduced. However, the fact that the numbers of people who use the Salvation Army's shelters and that numbers of those who sleep roughly have increased so significantly in the EU over the last 10 years, documents that the homelessness problem in EU remains severe. The statistical and diagnostic evidence	

elderly, and people living in poor built conditions. Again, disproportionate information is proposed for homeless. Please clarify.	supporting the latter statement is provided in reference chapter.	