water

MDPI

Article

Flood Fatalities in Europe, 1980–2018: Variability, Features, and Lessons to Learn

Olga Petrucci [1,*], Luigi Aceto [1], Cinzia Bianchi [2], Victoria Bigot [3], Rudolf Brázdil [4,5], Susana Pereira [6], Abdullah Kahraman [7], Özgenur Kılıç [7], Vassiliki Kotroni [8], Maria Carmen Llasat [9], Montserrat Llasat-Botija [9], Katerina Papagiannaki [8], Angela Aurora Pasqua [1], Jan Řehoř [10], Joan Rossello Geli [11], Paola Salvati [2], Freddy Vinet [3] and José Luis Zêzere [5]

1. CNR-IRPI National Research Council-Research Institute for Geo-Hydrological Protection, 87036 Rende (Cosenza), Italy
2. CNR-IRPI National Research Council-Research Institute for Geo-Hydrological Protection, 06128 Perugia, Italy
3. University Paul Valéry Montpellier 3, 34090 Montpellier, France
4. Department of Geography, Faculty of Science, Masaryk University, 61137 Brno, Czech Republic
5. Global Change Research Institute, Czech Academy of Sciences, 60300 Brno, Czech Republic
6. Centro de Estudos Geográficos, Instituto de Geografia e Ordenamento do Território, Universidade de Lisboa, 1600-276 Lisbon, Portugal
7. Department of Meteorological Engineering, Faculty of Aeronautics and Astronautics, Samsun University, Ondokuzmayis, Samsun 55420, Turkey
8. Institute of Environmental Research and Sustainable Development, National Observatory of Athens, 15236 Athens, Greece
9. Department of Applied Physics, University of Barcelona, 08028 Barcelona, Spain
10. Department of Geography, Faculty of Science, Masaryk University, 61137 Brno, Czech Republic
11. Grup de Climatologia, Hidrologia, Riscs i Paisatge, Universitat Illes Balears, 07122 Palma de Mallorca, Spain

* Correspondence: olga.petrucci@irpi.cnr.it

Received: 31 July 2019; Accepted: 9 August 2019; Published: 14 August 2019

Abstract: Floods are still a significant threat to people, despite of the considerable developments in forecasting, management, defensive, and rescue works. In the near future, climate and societal changes as both urbanization of flood prone areas and individual dangerous behaviors could increase flood fatalities. This paper analyzes flood mortality in eight countries using a 39-year database (1980–2018) named EUFF (EUropean Flood Fatalities), which was built using documentary sources. The narratives of fatalities were investigated and standardized in the database reporting the details of the events. The entire dataset shows a stable trend on flood fatalities, despite the existence of individual increasing (Greece, Italy, and South France) and decreasing (Turkey and Catalonia) trends. The 2466 fatalities were mainly males, aged between 30–49 years and the majority of them happened outdoor. Most often people were dragged by water/mud when travelling by motor vehicles. Some cases of hazardous behaviors, such as fording rivers, were also detected. The primary cause of death was drowning, followed by heart attack. This work contributes to understand the human–flood interaction that caused fatalities. The changes in society's vulnerability highlighted throughout this study contribute to manage future risks, to improve people protection actions, and to reduce risk behaviors.

Keywords: flood; fatality; spatiotemporal variability; risk; vulnerability; Europe

1. Introduction

Disaster-Resilient Societies, being prepared for and securing itself in case of natural disasters, is the standard to tend towards in order to improve the functioning of any society, in line with the Sendai Framework for Disaster Risk Reduction [1]. Among natural disasters, floods pose a significant threat to people, despite the noteworthy improvements in forecasting, emergency management, and realization of protective works. In developed countries, floods causing multiple fatalities are gradually disappearing, and in their place, there are a higher number of cases with fewer deaths per event [2,3]. However, the mean death tolls are still high in developing countries [2,4]. Several studies argue that economic development can reduce the vulnerability of a society to natural hazards, even if the relationship between economic growth and vulnerability shows considerable variations [5]. Moreover, vulnerability levels in low- and high-income countries have been converging, due to a relatively strong trend of vulnerability reduction in developing countries [5,6].

Flood management is a key societal challenge and becomes increasingly urgent due to the urbanization of flood-prone areas and extreme events' exacerbation related to climate [7]. The employment of structural flood protection measures, beside their intended benefits, generate unintended effects which, paradoxically, seems to increase risk. Measures such as levees or flood-control reservoirs, increasing flood protection, can attract settlements and high-value assets in the areas "protected", due to a sense of complacency, which can dangerously reduce preparedness. These paradoxical risk changes have been described as a "levee effect", "safe development paradox", or "safety dilemma" [8]. As far as nonstructural measures as warning systems, the possibility to successfully implement them depends on run-off times.

Due to the mentioned constraints, the most proficient strategies to increase people's resilience to floods seem to be found on educational campaigns, teaching individuals how to behave in the case of flood, and avoiding risky situations, such as driving through floodwater or swimming in a flooded river [9]. This goal involves several subjects: The scientific community, decision-makers, emergency management organization, and, finally, individuals. Actually, it is useless to blame human behavior if governments and civil society organizations do not design and implement policies for educating people on how to protect themselves.

Due to changes in societies, land use, and policies, flood impacts on individuals have changed over time, either increasing or decreasing.

Flood impact can decrease because of modifications in habits and behaviors, due to both generalized improvement of the cultural level of population at large, and to the diffusion of facilities and technologies.

Thanks to the introduction of current water in houses, individuals' exposure to flood risk decreased throughout the centuries, because they gradually can use water into their houses instead of washing their cloths into river water. Furthermore, in recent decades, mobile phones seemed to be determinant in saving lives. Looking at the recent floods' chronicles, it is quite common that people threatened by floods call for help using their mobile phone, even if this was something unimaginable in the first half of the 20th century. The use of social media also provides further possibilities to alert people about dangerous situations related to flood, thus decreasing the exposure to risk.

On the other hand, flood impact may increase because of increasing individual exposure. For example, the growing personal trust in high-performances of SUV (Sport Utility Vehicle) and pickups can encourage hazardous behaviors such as crossing rivers [10]. Moreover, due to cheaper ground in river plains, urbanization created permanent settlements of large numbers of persons permanently living in flood-prone areas.

To detect the changes in people–flood interaction, highlighting safe/unsafe personal behaviors and their temporal evolution, it is necessary to observe flood fatalities (FF) occurring throughout a long period. Moreover, it is significant to compare people–flood interactions in different countries and cultural environments, in order to detect either common features or differences characterizing each specific community. The study of past floods with fatalities supplies the "lessons to learn" to reduce victims of (inevitable) future floods, by identifying vulnerable groups and ranking circumstances in terms of dangerousness, and by making educational campaigns aiming to promote flood risk consciousness and defensive behaviors, instead of risky behaviors [11]. In future projections, materialized flood risk largely results from human behavior and future risk increases can be contained using disaster risk reduction strategies [6]. Thus, the future challenge is to develop efficient adaption strategies, also taking into account the expected exacerbation of rain regimes as an effect of climate change [7].

The probability to die during a flood essentially depends on some physical parameters characterizing the flood-human's interaction, as water speed, height of water level and water turbidity during the flood. The employing of data on real situations for people impacted by floods, supply tangible data to improve people–flood interaction models based on laboratory tests [12].

The majority of papers reporting food fatalities catalogues on large territories throughout long periods, essentially report the number of victims, focusing on flood seasonality and water speed [13,14]. Even exploiting information sources as the first responders, the characterization of FF in demographic and behavioral terms is not presented [15]. Some scholars investigated behavioral choices leading to fatal events [16], especially if related to the use of motor vehicles [17]. Nevertheless, there are no cases of databases collecting altogether data on FF occurrence in different countries, at a 'supra national scale', as in the present paper (except the previous paper of this research, [18]).

The present research compares the series of FF for the 39-year period (1980–2018) in eight European countries (Czech Republic, France, Greece, Israel, Italy, Portugal, Spain, and Turkey). The aim of the paper is to detect vulnerability and behavioral features leading to fatal events, and to identify changes in individual flood vulnerability throughout the years. Section 2 of this paper describes regions studied, database structure and the methodological approach. Section 3 presents data analysis at national levels. Section 4 discusses the results obtained using the whole dataset and compares them with results obtained in the regions studied. Section 5 outlines the features characterizing flood–victim interaction and its evolution throughout the time, highlighting how to use the results and what can be the most fruitful future research directions.

2. Materials and Methods

The present research is the second phase of a project that started in 2017 aiming to create MEFF (MEditerranean Flood Fatalities) database, including flood fatalities that occurred on a 36-year period (1980–2015) in five study areas located in the Mediterranean area [18]. Regions analyzed in MEFF were the following: (1) Calabria (Italy); (2) Languedoc-Roussillon, and Provence-Alpes-Cote d'Azur (France); (3) Catalonia (Spain); (4) Balearic Islands (Spain); and (5) Greece.

The focus was on flood fatalities, defined as people who lost their life due to floods. The methodological approach was based on the systematic collection of fatal events descriptions from documentary sources and the disaggregation and systematization of all the available information in the fields of MEFF. Data analysis, on one hand supplied a series of results [18], and on the other hand, suggested further clues to be investigated. Thus, to enlarge the database, we searched for new study areas where inventories of flood damage were available. We identified four new countries (Table 1): (1) Czech Republic, (2) Israel, (3) Portugal, and (4) Turkey, that provided data on flood fatalities. We sent to each one of the new partners an empty template of MEFF to fill FF for their study area in the 1980–2018 period. Simultaneously, the original study areas in MEFF were extended by fatalities to 2018 and the Calabria was substituted by entire Italy. By these activities, the new EUFF (EUropean Flood Fatalities) database was created (see Section 2.2).

Table 1. Comparison of the MEFF (MEditerranean Flood Fatalities) and EUFF (EUropean Flood Fatalities) databases.

DB	Countries	Study Areas	Area (km^2)	Inhabitants	Period	#EV	#FF
MEFF	1. France 2. Greece 3. Italy 4. Spain	1. *South France* 2. *Greece* 3. *Calabria* 4. *Catalonia* 5. *Balearic Islands*	237,461	28,629,102	1980–2015	162	458
EUFF	1. France 2. Greece 3. Italy 4. Spain 5. Czech Republic 6. Israel 7. Portugal 8. Turkey	1. *South France* 2. *Greece* 3. *Italy* 4. *Catalonia* 5. *Balearic Islands* 6. *Czech Republic* 7. *Israel* 8. *Portugal* 9. *Turkey*	1,500,280	198,294,466	1980–2018	812	2466

#EV: number of events of fatal floods; #FF: number of flood fatalities.

2.1. Study Areas and Information Sources

Data collection and analysis of FF was carried out for nine Study Areas (SA) located in eight countries. The entire area further analyzed is named total area (TOT-A) (Figure 1), while for the SA the following acronyms are used: (1) Czech Republic: CZE; (2) Israel: ISR; (3) Italy: ITA; (4) Turkey: TUR; (5) Greece: GRE; (6) Portugal: POR; (7) South France: SFR; (8) Catalonia: CAT; (9) Balearic Islands: BAL. Table 2 shows the area of each SA and their general demographic data. Turkey is the largest (52.2% of TOT-A surface) and most populated (41.4% of the TOT-A population). Average population density is 182 inh/km^2: the largest value pertains to Israel (378.1 inh/km^2) and the lowest to Greece (81.6 inh/km^2). The average age of population is around 41 years: the highest value pertains to Italy (48 years) and the lowest to Israel (31 years). On average, 48.9% of the population are males, and 51.1% females: the highest percentage of female pertains to Portugal (52.7%), while the lowest value (50.3%) pertains to both Israel and Balearic Islands.

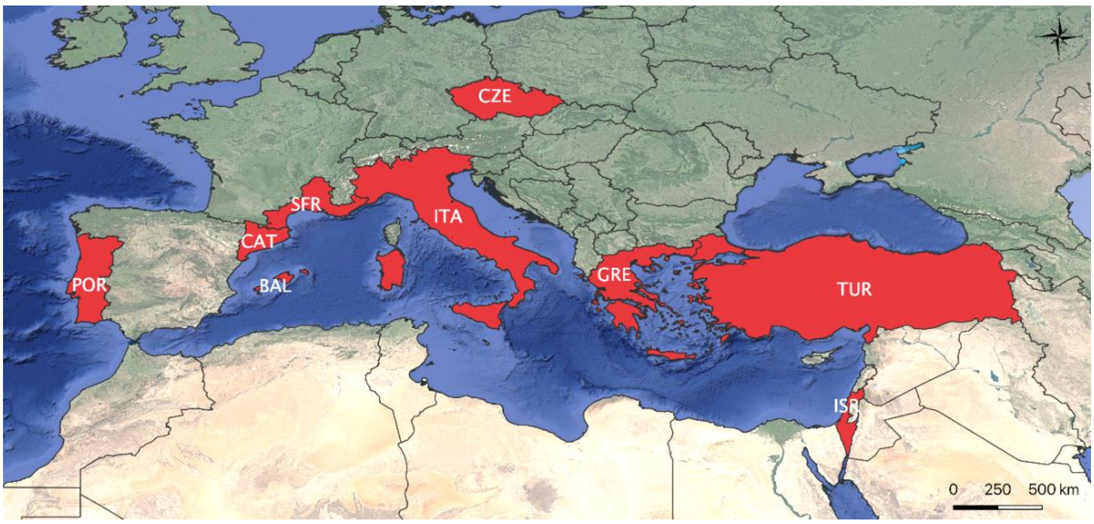

Figure 1. The study areas location (in red). Legend—CZE: Czech Republic; ISR: Israel; ITA: Italy; TUR: Turkey; GRE: Greece; POR: Portugal; SFR: South France; CAT: Catalonia; BAL: Balearic Islands.

Table 2. Characteristics of the study areas.

ACR	Country/*Region*	Area (km^2)	Area (%)	#Inh	Inh (%)	PD	AA	Males (%)	Females (%)
CZE	Czech Republic	78,865.0	5.3	10,553,843.0	5.3	133.8	43	49.1	50.9
ISR	Israel	22,072.0	1.5	8,345,000.0	4.2	378.1	31	49.7	50.3
ITA	Italy	301,338.0	20.1	60,483,973.0	30.5	200.7	48	48.7	51.3
TUR	Turkey	783,562.0	52.2	82,003,882.0	41.4	104.7	32	49.2	50.8
GRE	Greece	131,957.0	8.8	10,768,477.0	5.4	81.6	45	49.3	50.8
POR	Portugal	92,212.0	6.1	10,254,666.0	5.2	111.2	46	47.3	52.7
SFR	France *Languedoc-Roussillon, Provence-Alpes-Cote d'Azur*	53,874.0	3.6	7,233,580.0	3.6	117.0	42	48.1	51.9
	Spain								
CAT	*Catalonia*	32,108.0	2.1	7,543,825.0	3.8	235.0	42	49.1	50.9
BAL	*Balearic I.*	4,292.0	0.3	1,107,220.0	0.6	258.0	40	49.7	50.3
	Total	1,500,280		198,294,466					
	Average	166,698		22,032,718		182	41	48.9	51.1
	Maximum	783,562		82,003,882		378	48	49.7	52.7
	Minimum	4292		1,107,220		82	31	47.3	50.3

ACR: acronyms; country/region: the country and, in the cases of sub national scale, the region analyzed; area (km^2): surface of the study area; area (%): surface of the study area as percentage of TOT-A; #Inh: number of inhabitants; Inh %: Inhabitants of the SA as percentage of TOT-A; PD: population density (Inh/km^2); AA: average age (years); males (%): % of males in the population of the SA; females (%): % of females in the population of the SA. Source for AA, males % and females %: www.Worldometers.info (data 2019), accessed 10 June 2019.

(1) Czech Republic (CZE)

The Czech Republic (until 31 December 1992 the western part of Czechoslovakia) is located in Central Europe. It has an indented morphology represented by lowlands, highlands and mountains with altitudes between the lowest point at the north-west in Hřensko (115 m a.s.l.), and the highest point in Sněžka Mount (1603 m a.s.l.). The annual precipitation has a maximum in summer and a minimum in winter, and totals fluctuate between 400 mm and 1450 mm. CZE represents 5.3% of the surface, and 5.3% of population of TOT-A, with a population density of 133.8 inhabitants per km^2. The average age of population is 43 years and 50.9% of the population is made of females. Data of flood victims comes from historical-climatological database of the Institute of Geography, Faculty of Science, Masaryk University in Brno, collected from different documentary evidence. Newspaper information was dominant in the 1980–2018 period, partly complemented by professional papers describing outstanding events and notes of observers at meteorological stations of the national network.

(2) Israel (ISR)

In this SA, four physiographic regions can be distinguished: (i) The coastal plain, with elevation from 10–20 m to about 100 m a.s.l., that extends from the Mediterranean Sea to the foothills. (ii) The central mountain belt, including the Galilee, Samaria and Judea mountains, with elevations between 500 m and 1000 m a.s.l. (iii) The Rift Valley area, a linear depression trending north–south. The Southern Negev desert covers almost half of the country, bordering in the south to the Red Sea. Climate varies from arid to semi-arid and humid. ISR represents 1.5% of the area and 4.2% of population of TOT-A, with a population density of 378.1 inhabitants per km^2. The mean age of population is equal to 31 years. Females represent 50.3% of the population. Moshe Inbar conducts a database for natural hazards in Israel at the Department of Geography and Environmental studies, in the University of Haifa, for the period between 1948 and present days. The natural hazards include earthquakes, floods, landslides, droughts, and forest fires. Data source for human victims are newspapers and radio news. For the present work, only flood fatalities were extracted from the mentioned database.

(3) Italy (ITA)

The territory of Italy consists of a peninsula and 2 main islands located in the middle of the Mediterranean basin. More than $\frac{3}{4}$ of the territory is formed by mountains and hills. The highest elevations are reached on the Alps (>4500 m a.s.l.). Except for the Pianura Padana, flat areas are not very numerous and vast: they are located along the main rivers and on some costal sectors. Northern areas show very cold winters, with hot and humid summers, and mean annual rain reaching 3000 mm. In central part, the climate is milder, while Southern regions and the islands generally fit to the Mediterranean climate and have the lowest mean annual precipitation (around 300 mm). ITA represents 20.1% of the area, and 30.5% of population of TOT-A, with a population density of 200.7 inhabitants per km^2. Inhabitants of ITA are on average 48 years old. 51.3% of the population is made of females. Data on FF were collected at CNR-IRPI (Italian acronym of National Research Council-Research Institute for Geo-Hydrological Protection) by systematically surveying national newspapers. They were already partially published in papers dealing with human impacts of both landslides and floods [19–21].

(4) Turkey (TUR)

Turkey has a very complex topography, with mostly W–E oriented mountains. Mountains block the moist air flow towards inlands, resulting in a dry climate in the interior, and moist and mild climate in the south, west, and north of the country. Eastern part has relatively higher altitudes (up to 5137 m), with severe winters, while the southeast area has more semi-arid climate characteristics. Average annual precipitation is 574 mm; internal regions have only 250 mm, while the figure in northeast coast exceeds 2000 mm. With 783,562 km^2, TUR covers 52.2% of TOT-A, and accounts for 41.4% of the population of TOT-A. However, the population density is only 104.7 inhabitants per km^2. The average age of population is 32 years and females include 50.8% of the population. The flood fatalities data comes from the Turkish Severe Weather Database, which is built (and continuously updated) using official hazardous weather records, newspaper archives, voluntary reports, and other sources. The database includes tornadoes, severe hail, damaging winds, floods, lightning fatalities, and injuries. Further details regarding the database are discussed in several papers [22–24]. For the present work, only flood fatalities were extracted from the mentioned database.

(5) Greece (GRE)

Greece is mostly a mountainous country (about 80% of the territory) with the highest Mount Olympus (2917 m a.s.l.). It also has a complex land–water distribution with numerous islands forming a coastline in the length of 13,676 km. It is characterized by a Mediterranean climate. Mean annual totals up to 400–600 mm are observed over the eastern part of continental Greece, while the islands of the Aegean Sea are much drier. GRE represents 8.8% of the area and 5.4% of population of TOT-A, with the population density achieving only 81.6 inhabitants per km^2. The mean age of population is equal to 45 years and females create 50.8% of the population. Data were obtained by the database of the National Observatory of Athens on high-impact weather events in Greece [25], enriched with details on victims gathered by the newspapers Rizospastis and Ethnos, reliable media websites, and the community of amateur meteorologists.

(6) Portugal (POR)

Portugal is located in the southwest of the Iberia Peninsula. The elevation ranges from 0 m a.s.l., near the coast, to 1993 m a.s.l. in the Central Mountain range. The climate is controlled by the transition between the Mediterranean and the Atlantic conditions. The mean annual precipitation is around 900 mm, ranging from less than 500 mm in northeast and south, to more than 2000 mm in the northwest mountains. Rainfall amounts tend to increase with increasing latitude, elevation and proximity to the Atlantic Ocean. POR accounts for 6.1% of the area and 5.2% of population of TOT-A, with a population density of 111.2 inhabitants per km^2. The mean age of population is equals to 46 years and the percentage of female population is 52.7%. The Disaster Database [26], based on a systematical collection of floods and landslides that have caused human damages in Portugal referred to in newspapers, is the main data source. Details about flood victims were further complemented with media websites and published papers about flood fatalities [3,27].

(7) South France (SFR)

The SFR includes the former region Languedoc-Roussillon (now part of Occitan region) and Provence-Alpes-Cote d'Azur regions. Ponds and deltas are typical of the lowland in the western part (Languedoc). The relief is steeper and valleys deeper in the eastern part (Provence). The coastal plains are surrounded by 2500 m high summits in the Pyrenees and the Alps, and 1500 m in the Cévennes. The summer drought and the intense rainfall in autumn are the key features of the climate. The rainfall concentrates over the period September–December (50% of annual total). Winter is drier with cold continental winds. SFR represents 3.6% of the area and 3.6% of population of TOT-A, with a population density ranging from 78.1 inh/km^2 (Languedoc-Roussillon, Midi-Pyrénées) to 156 inh/km^2 (Provence-Alpes-Cote d'Azur) with an average of 117 inhabitants per km^2. The mean age of population is equal to 42 years. Females represent 51.9% of the population. Data were collected by the department of geography of the University Paul Valéry Montpellier 3 (UMR GRED laboratory), starting from documentary sources and newspapers and complemented through post flood surveys published by the PhD of L. Boissier [28] and by Vinet and Boissier [29].

(8) Catalonia (CAT)

Catalonia (Spain) is a region in the northeast Iberian Peninsula. The most significant topographic features are the Pyrenees (over 2500 m a.s.l.), the Littoral range and the Pre-Littoral system, rising to higher than 500 m and 1200 m a.s.l., respectively. There are two wet seasons (autumn and spring) and two dry seasons (winter and summer). The mean annual precipitation can vary from 400 mm, in Central Depression, to 1200 mm, in the Pyrenees. CAT represents 2.1% of the area and 3.8% of population of TOT-A, with the population density equal to 235 inhabitants per km^2, 50.9% of females. However, the population is mainly concentrated along the coast. For instance, Barcelona (with a density of 15,866.95 inh/km^2) and two surrounding municipalities, concentrate 46% of the population of Catalonia. The mean age of population is 42 years. Data comes from the INUNGAMA database [30] that contains all the flood events that have produced socioeconomic impact between 1981 and nowadays. This database contains information such as the date, the counties and municipalities affected, the main rivers or basins involved, the impacts produced, and the type of flood. Information regarding victims has been complemented with newspaper data, mainly La Vanguardia, and official reports.

(9) Balearic Islands (BAL)

The Balearic Islands archipelago (Spain) is situated off the eastern coast of Spain. It consists from five islands (Mallorca, Menorca, Eivissa, Formentera, and Cabrera) with adjacent islets. Precipitation expresses a clear Mediterranean pattern, with a maximum during autumn and a minimum in summer. Mean annual totals range from 1000 mm, in Mallorca, to 300 mm, in the southern islands of Eivissa and Formentera. BAL, with 4492 km^2, accounts only to 0.3% of the area and to 0.6% of population for TOT-A. However, the population density achieves 258 inhabitants per km^2, 50.3% of which are females. Data were obtained from a PhD thesis [31], and complemented by research in regional newspapers, such as Diario de Mallorca and Ultima Hora, and by data gathered for the implementation of the Flood Prevention Plan.

2.2. EUFF Database

The limitations associated with documentary sources are widely addressed in literature [21,32,33]. The most important ones are as follows:

1. Data completeness depends on the scale: international news usually report only catastrophic events, while local media also mention events of smaller severity;
2. Data completeness and quality varie with time, and strongly increase in recent decades, due to news websites;
3. Details available can differ from one country to another (i.e., due to privacy laws, newspapers in some countries do not report the names of victims).

Because EUFF is a database of FF obtained from documentary sources, it can be affected by incompleteness, which is difficult to quantify. It is impossible to "validate" data in such a kind of database, because independent ancillary information does not exist: all available information is important for database compilation. The construction of the database is a sort of "artisanship work", where all the data found are exploited [18]. If new information becomes available, it is crosschecked with the previous data, and the database is updated accordingly.

Narratives of fatal events gathered from documentary sources were disaggregated in database fields describing victim's profile and the circumstances of the deaths. EUFF follows the data organization already tested in published papers [18,21,23,34]. Each row contains data about a single fatality, organized in fields clustered in six sections, the detailed description of which is available in [18] (2019). MEFF is publicly available but, due to privacy issues, names and surnames of FF are not included (https://data.mendeley.com/datasets/rh9mx7fh7b/1).

EUFF database contains 2466 FF that occurred between 1980 and 2018 in the 9 study areas. The main features of MEFF and EUFF databases are compared in Table 1. The fields of EUFF are very similar to those in MEFF and are reported in (Table 3).

Table 3. Sections and fields of EUFF database.

1. Record Identification	**2. Time**	**3. Location**	**4. Victim Profile**
Flood ID	Year Month Day	Country Region Municipality	Name Surname Gender Age
Fatality ID	Lightning conditions	Prefecture	Residency Disability
5. Victim-event Interaction			
Place	**Condition**	**Activity**	**Dynamic**
Indoor: Public/private building	By bicycle By boat By bus	Travelling to home/work Recreational activities Rescuing someone	Blocked in a flooded room Caught in a bridge collapse Caught in a road collapse
Outdoor: Bridge Campsite/tent	By car By caravan	Sleeping	Caught in building collapse Dragged by water/mud
Outdoor: Countryside Ford	By tractor By truck	Working	Fallen into the river
Outdoor: Recreation area Riverbed/riverside	By van Laying	Hunting	Surrounded by water/mud
Outdoor: Road Underpass/Tunnel	Standing	Fishing	Hit
6. Human Response			
Protective Behavior	**Hazardous Behavior**		**Cause of Death**
Climbing trees Driving to avoid danger Getting on roof/upper floor Getting out of cars Getting out of buildings Grabbing on to someone/something Moving to safer place	Check damage during the event Driving on a road close by police Fording rivers Refuse evacuation Refuse warnings Staying on bridges during floods Staying on river banks Trying to rescue animals Trying to save belongings Trying to save vehicles		Collapse/Heart attack Drowning Hypothermia Poly-trauma Poly-trauma and suffocation

2.3. Methods

As for data analysis in this paper, it is not focused on testing any existing hypothesis, but on information collection and explanation. This qualitative research method can be assimilated to the Grounded Theory Approach, a method of research accepted throughout the social sciences and nursing. This method is described as the "discovery of emerging patterns in data" with the aim to generate theory from the research situation in the field, as it is [35].

All the data discussed are available in the tables, both as numbers and as percentage of the total data available, in order to highlight their significance. We discuss the analyses performed using the whole dataset and compare them with working hypotheses available in literature and elaborations at the scale of study areas.

If we neglect for a while that the number of "FF" represents the number of people who lost their life, it can be argued that the number of "data" are not sufficient to perform complex statistical analyses, for this reason we performed simply descriptive statistical elaborations. Particularly, we present the assessed trend of #FF for TOT-A and SA, and we express it by using the slope angle of the trend line.

Using the large amount of data collected, we assessed seasonality of both events and fatalities and their relative trends. Moreover, we assess the trend of the number of fatalities per event, which represents, to a certain extent, the severity of the event with respect to people.

To compare the number of FF among the different SA, we introduced the Flood Impact Index (FII) that represents a normalization of the number of victims to the surface and population of the SA. It is defined as follows:

$$\text{FII} = \left(\frac{\#\text{FF}}{\#\ \text{Inhabitants}} \times 100{,}000\right) \times \left(\frac{\#\text{FF}}{\text{Area (km}^2)} \times 1000\right)$$

The ratio #FF/Inhabitants × 100,000 represents the flood mortality on the population of the SA, while #FF/Area (km^2) × 1000 actually represents the spatial density of flood fatalities in the SA.

3. Results

3.1. Spatiotemporal Analysis of Fatalities

Between 1980 and 2018, 812 floods killed 2466 people in TOT-A (Table A1). The highest numbers of FF were recorded in TUR (50.4%), followed by ITA (16.5%) and SFR (11.1%). On average, each event killed 3 people (AV#FF/EV), but this figure reaches the maximum in TUR (3.8) and the minimum in CZE (2.1) (Figure 2).

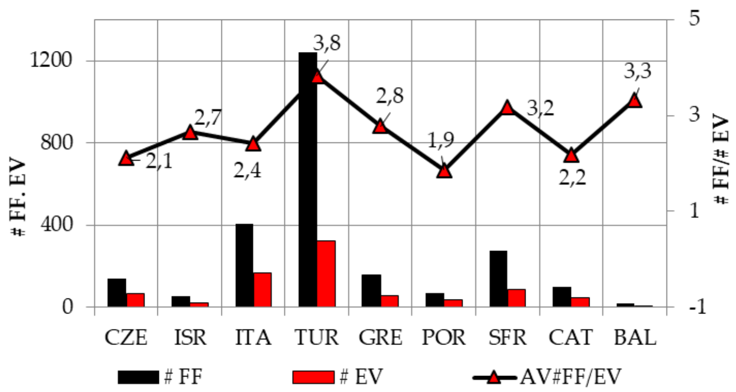

Figure 2. Number of fatalities (#FF), number of events (#EV) and mean number of fatalities per event (AV#FF/EV).

In TOT-A, the average number of fatalities per year (AV#FF/Y) is 63.2: the relatively highest portion of fatalities corresponds to TUR (31.9) and the lowest to BAL (0.5). The value of the ratio #FF/Area (km^2) × 1000 is 1.64, and reaches the highest values in BAL (4.66) and CAT (3.11). The ratio #FF/Population × 100,000 is 1.24, and it shows the highest value for SFR (3.77) and the lowest for ISR, ITA and POR (0.65).

During the 1980–2018 period, the general trend of FF seems quite stable and the number of fatalities per event slightly decreases, even though the situation is different for individual SA (Figure 3). Looking on SA linear trends, #FF is decreasing for TUR and CAT and increasing for GRE, ITA, and SFR. The number of fatalities per event (#FF/#EV) decreases in TUR and increases in GRE, CZE, and SFR. These graphs show that the annual amount of FF is very high in TUR (more than 50 in 6 years of the reference period), while there are other study areas where the maximum annual amount of FF did not surpass 5 fatalities (e.g., CZE and BAL), even if these values must be reported to the size and population of the SA.

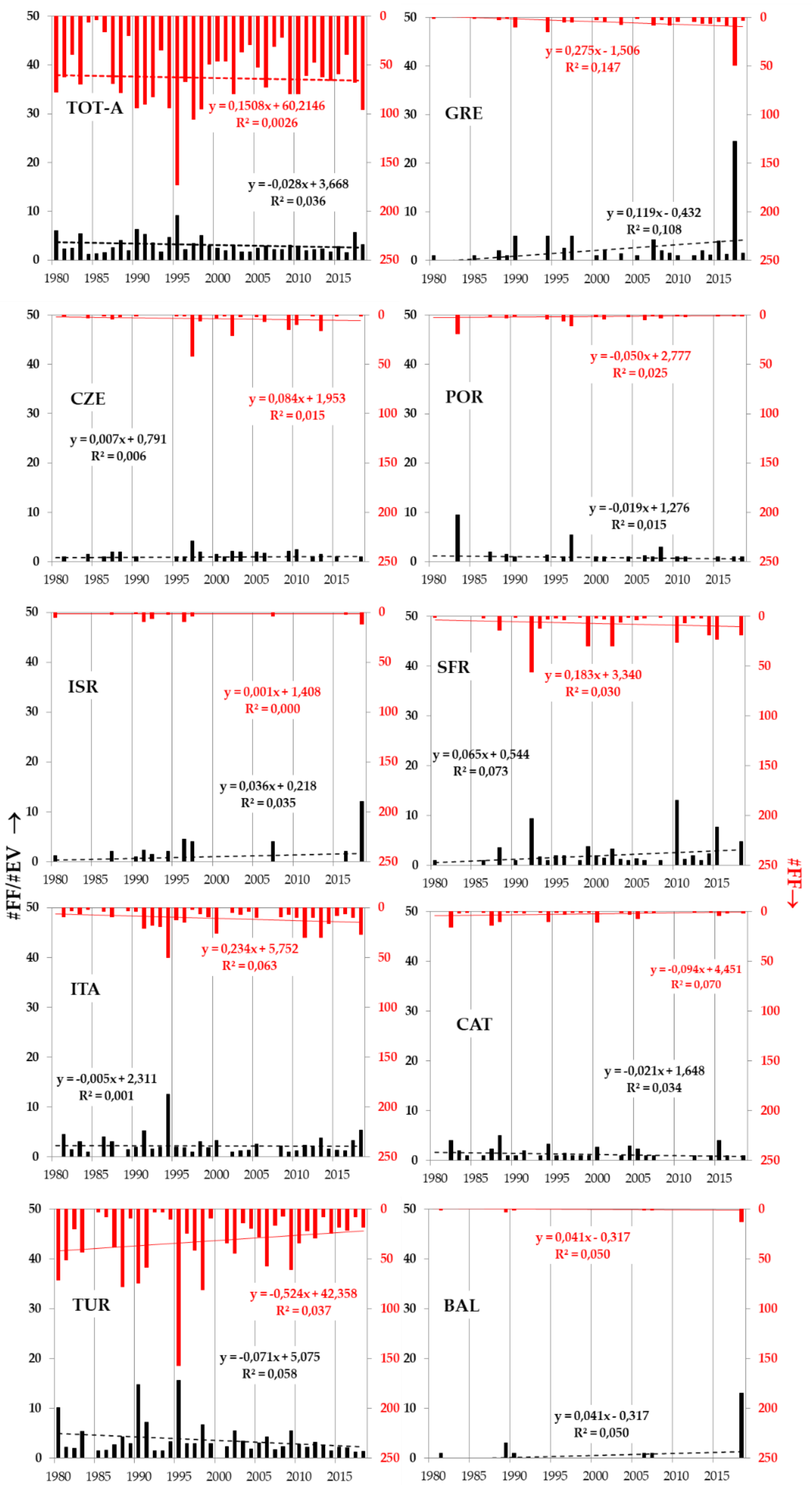

Figure 3. Annual variability in the number of fatalities (#FF, in red) and in the number of fatalities per event (#FF/#EV, in black), complemented by their linear trends.

Figure 4 shows the monthly numbers of fatalities (#FF), and monthly numbers of events (#EV). In TOT-A, 560 (69%) of events occurred between June and November, causing totally 1894 fatalities (77%). The events exhibit the maximum in October (122 events causing 360 fatalities, i.e., 15% of FF) and a secondary maximum in July (103 EV, causing 387 FF, i.e., 16% of FF). November was the most hazardous month in terms of fatalities (402, 16%). The peak in November reflects the general trend of TOT-A, while the one in July (387, 16%) is strongly affected by the high number of FF recorded in TUR (307, 12%). Monthly distribution of FF is highly affected by the climate features and monthly distribution of rainfall in each SA.

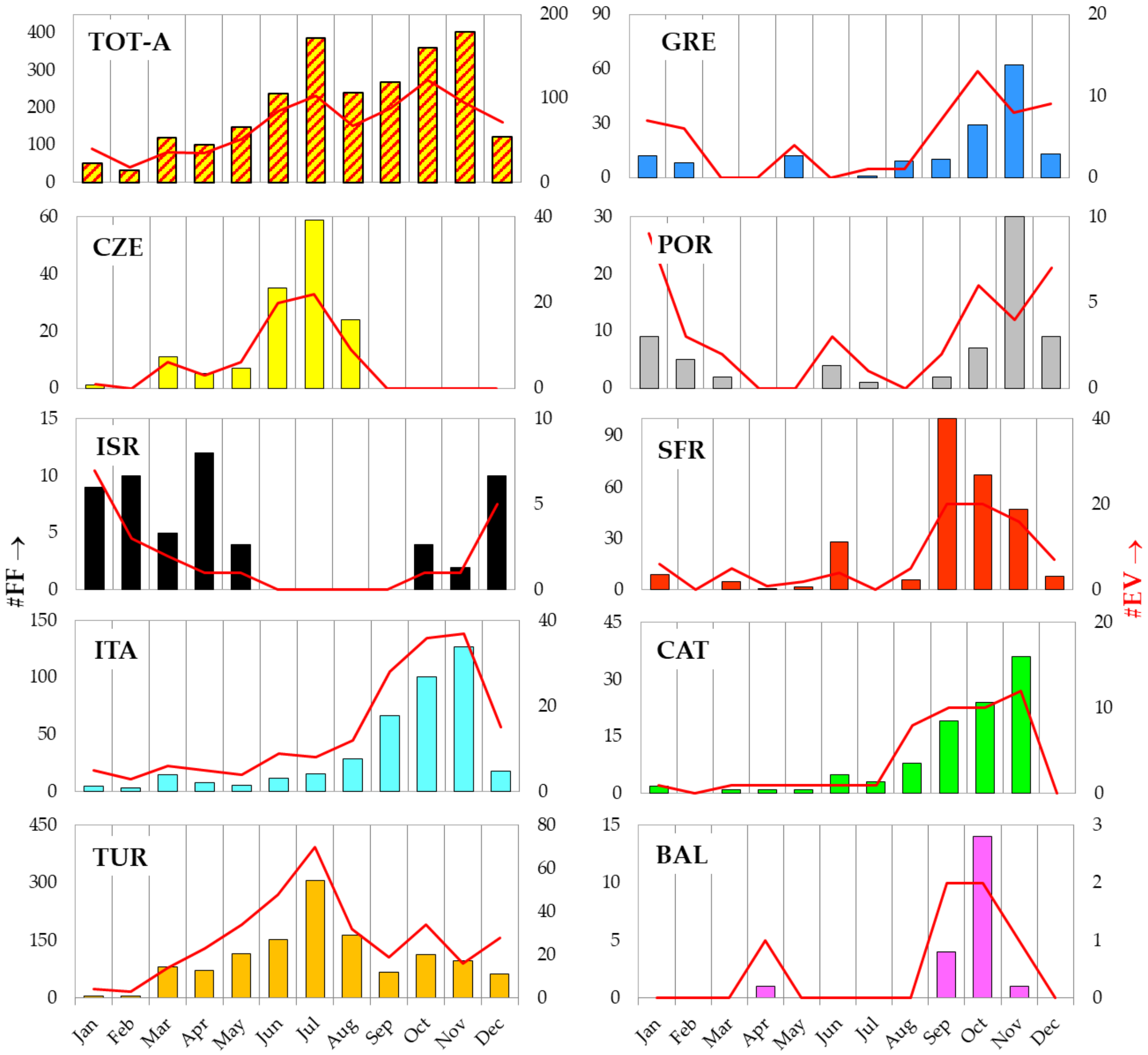

Figure 4. Monthly variation of flood fatalities (#FF, bars) and flood events (#EV) per each study area (SA).

By rescaling our results using the Flood Impact Index (Table 4) it must be noted that the largest impact pertain to SFR, where the number of FF is very high, if normalized to both population and extent of the territory (19.12). The second value of FII pertains to BAL (8.42), followed by CAT (4.13).

Table 4. Flood Impact Index (FII).

Study Area	Area (km^2)	#Inh	#FF	#FF/#Inh × 100,000	#FF/Area × 1000	FII
CZE	78.865	10.553.843	142	1.35	1.80	2.42
ISR	22.072	8.345.000	56	0.67	2.54	1.70
ITA	301.338	60.483.973	407	0.67	1.35	0.91
TUR	783.562	82.003.882	1.243	1.52	1.59	2.40
GRE	131.957	10.768.477	156	1.45	1.18	1.71
POR	92.212	10.254.666	69	0.67	0.75	0.50
SFR	53.874	7.233.580	273	3.77	5.07	19.12
CAT	32.108	7.543.825	100	1.33	3.11	4.13
BAL	4.292	1.107.220	20	1.81	4.66	8.42

By splitting the study period in decades, and looking at the line slope for #FF of the different SA, further 'qualitative' details can be noticed (Figure 5). The decades 1980–1989 and 1990–1999 show negative trends for 5 SA and very low positive trend for the others, while in 2000–2009 and 2010–2018, TUR, ISR, and particularly GRE show an increasing trend of the number of FF. Clearly, it must be taken into account that, due to the number of data and possible gaps that, in general, can affect historical data, these indications can be considerated as approximated.

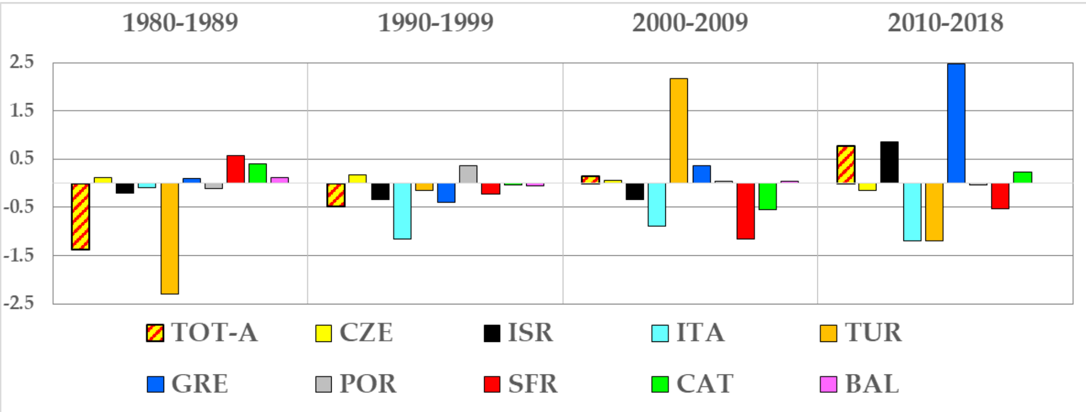

Figure 5. Decadal trends of #FF in SA and TOT-A, represented by the slope of the trend in each SA.

3.2. Basic Features of Fatalities

In this section, we summarize the main relationships between the variables characterizing the fatal events, referring to the further quoted appendices. Figure 6 presents the relationships between gender and the other variables, while Figure 7 presents the relationships between age of FF and the other variables.

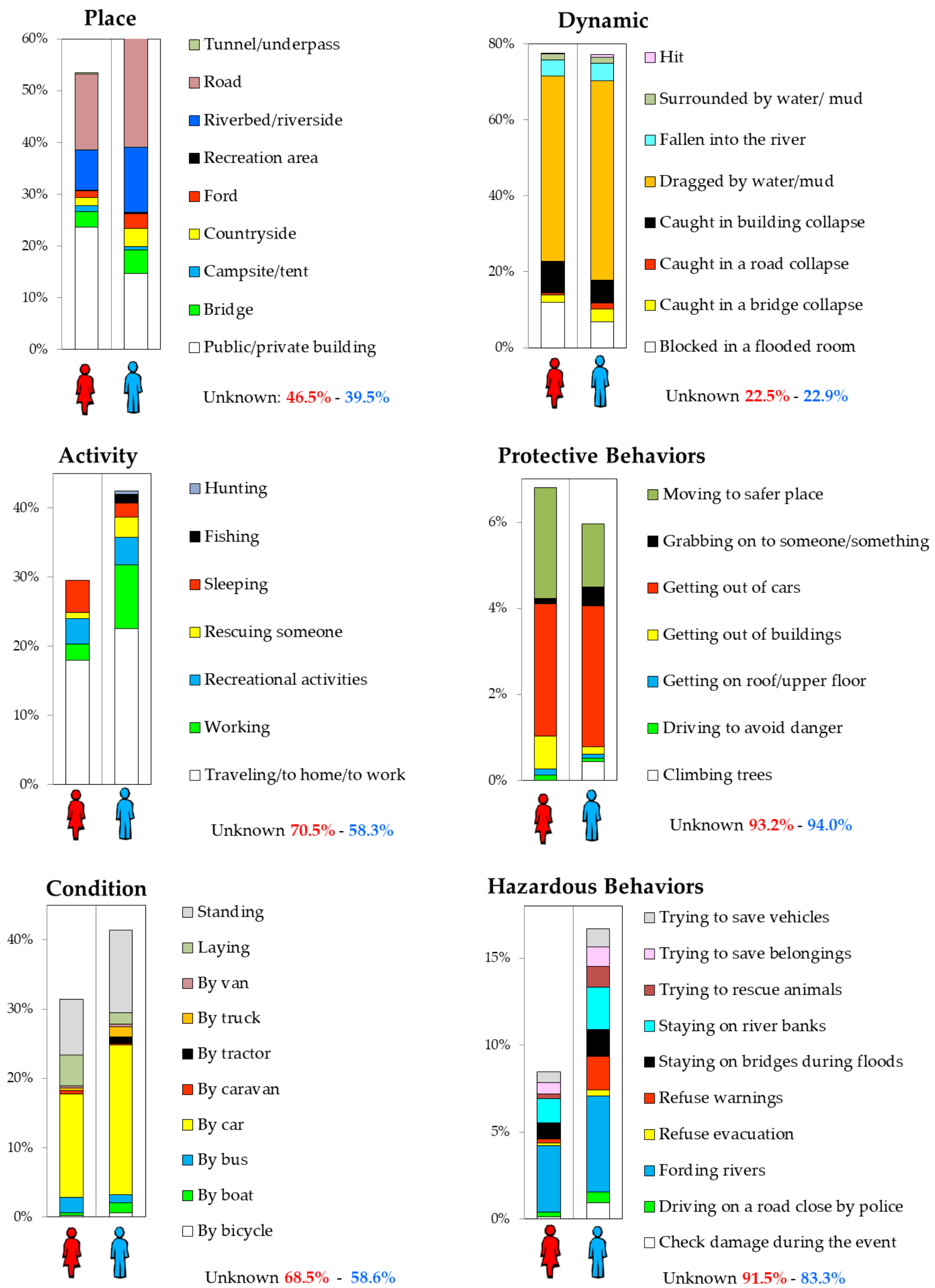

Figure 6. Relationships between gender and place, activity, condition, dynamic, protective, and hazardous behavior, for the victims of known gender (1936, 78.5% of FF). Unknown percentages are in red for females and blue for males.

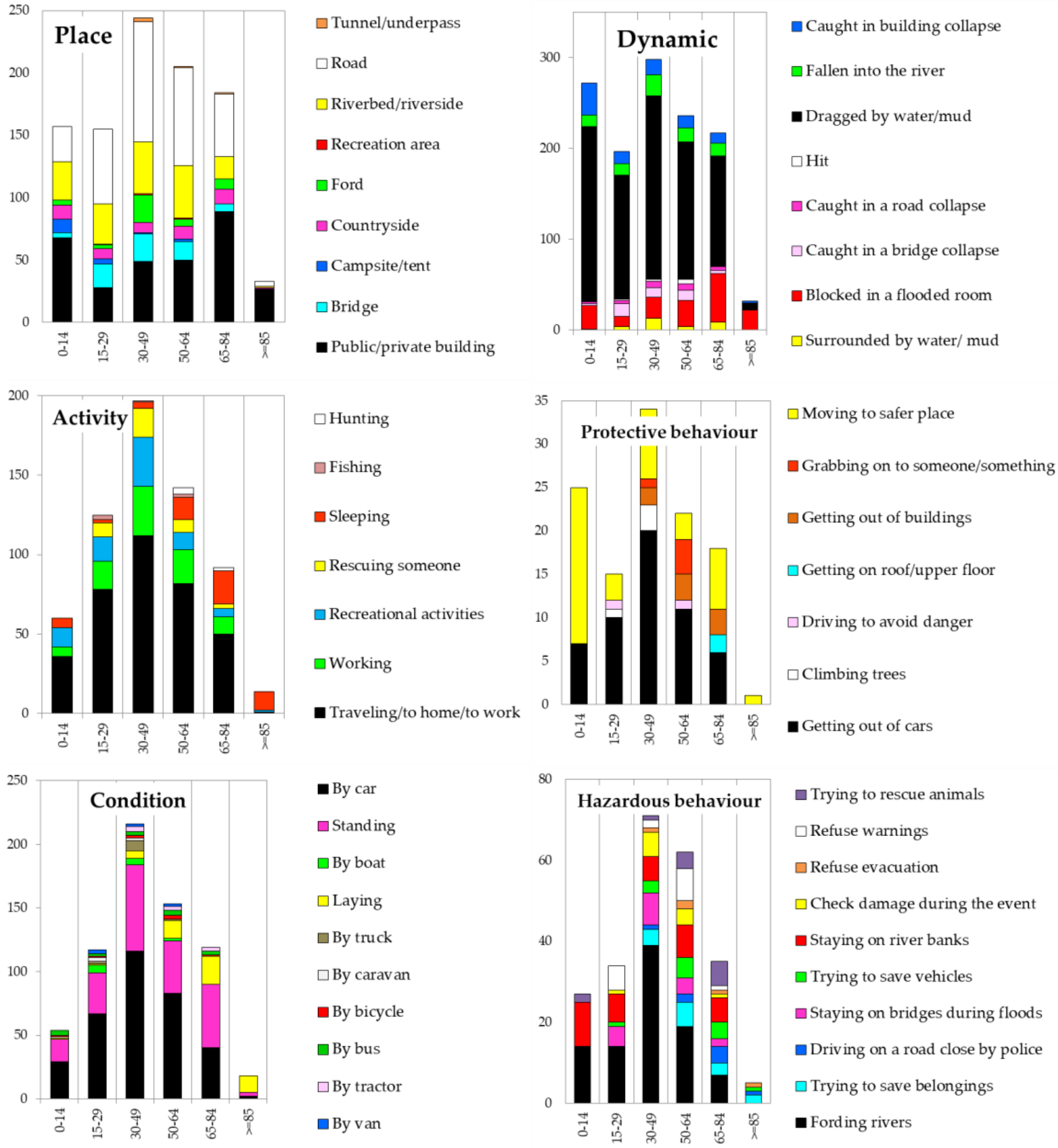

Figure 7. Relationships between age and place, activity, condition, dynamic, protective, and hazardous behavior, for the flood fatalities (FF) of known age (1577, 64.4%).

- Light conditions. There is evidence that dark conditions worsen the situation, causing a slightly greater percentage of FF in TOT-A, as can be inferred by the higher value of FF in dark conditions in SAs where data on this variable are almost complete, as in GRE, POR, and ITA (Table A1).
- Gender. For TOT-A, fatalities were mainly males (46.9%). Looking at the SA, males represent the larger percentage of FF (Table A1). The largest difference between genders pertains to CZE (71.1% males, 21.8% females, and 7% not reported), followed by GRE (68.6% males, 30.1% females, and 1.3% not reported).
- Age. The majority of fatalities were in the age of 30 ÷ 49 years (15%), followed by 50 ÷ 64 years (13%) and 65–84 (12.9%) (Table A1). Females were more numerous than males in the following classes: <15 years, 15–29 years, 65–84 years, and over 85 years (Figure 8).

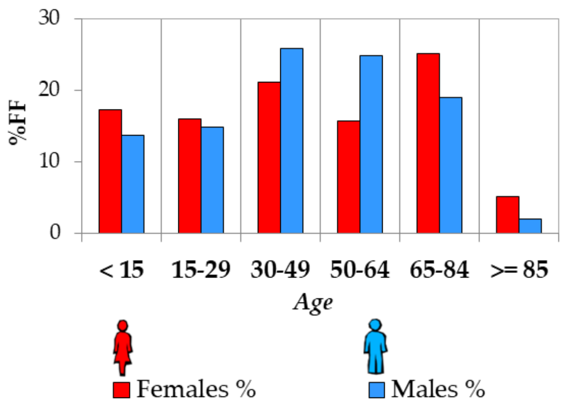

Figure 8. Proportion of male and female fatalities per classes of age for total area (TOT-A).

- Residency. The majority of victims were residents in the area where the fatal events occurred (1307 fatalities, i.e., 53%).
- Disability. 2.2% of victims were described as affected by some kind of physical disability (Table A2). Due to the relatively low number of people reported as disable, it is actually impossible to assess if disabilities represent a factor that affects the occurrence of fatal events.
- Place. Fatal events occurred more frequently outdoor (823 FF, 33.4%), and particularly on the roads (404 FF, 16.4%) (Table A2).
- Condition. By car was the most frequent condition of fatality for TOT-A (15.9% of cases) (Table A3). If we analyze motor vehicles altogether (bus, car, caravan, tractor and van), the percentage of cases rises until 19.8%. Condition slightly differs among males and females, but fatality by car was the most frequent for both genders. In all but the over 85-year fatalities, the majority of victims were by car and secondly standing.
- Activity. Traveling/to home/to work was the most frequent activity in which victims were involved at the moment of fatal events, both in TOT-A (445, 18%) and in all SA, except CZE, POR, and SFR (Table A3). This is true for both males and females. Males were working and females were doing recreational activities. Stronger differences pertain rescuing someone, more frequent among males than females, and hunting and fishing, detected only in cases of male fatalities. Traveling/to home/to work was found to differ among the age categories. Fatalities for people over 85-years occurred while either sleeping or doing recreational activities.
- Dynamic. Dragged by water/mud was the most frequent dynamic of fatal events in TOT-A (1231, 49.9%) (Table A4). The victims under 85 years were more commonly dragged by water/mud, while people above 85 years were very likely to be blocked in a flooded room.
- Protective behaviors were detected in 130 FF (5.3%) (Table A4). Even if the protective attempts were unsuccessful, we identified mainly attempts to get out of car (62, 2.5%) and moving to safer place (44, 1.8%). Among people for whom we have corresponding information, females were more numerous than males. Concerning the classes of age, the majority of people showing protective behavior were in the class 30–49 years, surprisingly followed by children (0–14 years).
- Hazardous behaviors were detected in 262 FF (10.6%), and the majority of cases concerns males (Table A5). This may be associated with the lower level of flood-risk perception attributed to males, according to recent research targeting Greek population [36]. People exhibiting hazardous behavior were first between 30 and 49 years and secondly between 50 and 64 years. The majority was either fording rivers (95, 3.9%), as frequently reported in literature [37,38] or staying on river banks (40, 1.6%) and staying on bridges during floods (25, 1%). Fording rivers were the most frequent hazardous behavior among both females and males. Almost all the types of hazardous behaviors were detected in people in the ages between 30 and 64 years. After 30 years, trying to

save cars and belongings were often detected, while in people older than 50 years, also refuse warning and refuse evacuation were detected.

- Cause of death. Six types of clinical causes of death were reported, although in different environments the list must be updated. In TOT-A, the cause of death was mainly drowning (1693 FF, 68.7%) (Table A5). Collapse/heart attack caused 237 (9.6%) fatalities. Surprisingly, the victims killed by collapse/hearth attack seem common in all the classes of ages, and not restricted to elderly fatalities, as could be expected (Figure 9).

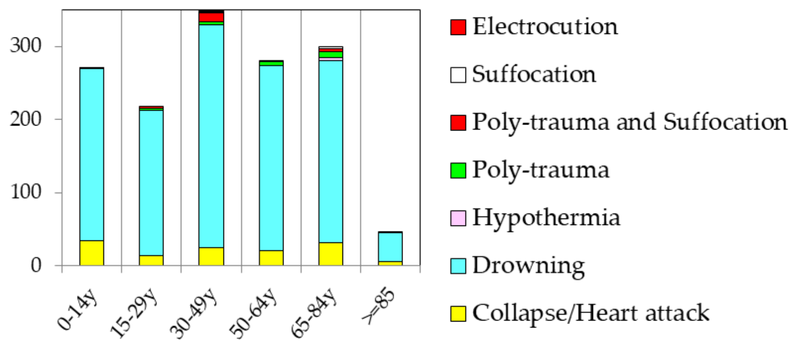

Figure 9. Number of fatalities (on y-axis) sorted per age (x-axis) and cause of death for TOT-A.

4. Discussion

Data collected in the individual SA present different levels of completeness concerning variables describing fatal events. Then, the reliability of data for each variable is measurable using the percentages of cases known. Based on these percentages, results obtained for each variable can be considered either reliable or purely indicative, thus requiring further investigation.

4.1. Data Numerousness

Simplifying the approach presented by [18], we defined data reliability as high, medium, and low.

a. Variables of low reliability (data available between 0% and 30% of the total):

   - Protective and Hazardous behaviors were reported in 5.3% and 10.6% of the cases, respectively, thus they are not strictly representative of all what really happened. Data about hazardous behavior were not gathered in ISR and BAL, because the data sources did not reported details on this, while in POR were detected for 47.8% of its fatalities.
   - Disability: probably due to privacy reasons, the narratives of the events are not very explicit about this factor. In addition, we were not sure that this information was correctly reported, even in the events more accurately described. The cases declared of disability are only 54 (2.2%).

b. Variables of medium reliability (data available between 60% and 30% of the total):

   - Activity is available only in 32.0% of the cases, and data are most abundant for GRE (71.2%) (Figure 10).
   - Condition is available only in 32.2% of the cases. This variable is quite complete for CAT (86.0%) and ITA (78.6%).
   - Light conditions are known for 41.1% of the cases. Data completeness is the highest for GRE (97.4%). For ISR, no such data were available.
   - Place where the accidents occurred is available for 51.5% of cases. The completeness of data is high for ITA (95.8%) and CAT (94%), and low for SFR (9.5%).

c. Variables of high reliability (data available between 100% and 60% of the total):

- Residency of the victims was available in 60.1% of cases. Data completeness is the highest for GRE (88.5%) and CAT (80%) and very low for ISR (1.8%).
- Age of FF is available in 64.4% of cases. This information is completely available for BAL (100%), almost complete for ITA (99.3%) and SFR (95.2%), and less abundant for the remaining SA (for ISR only 26.8%).
- Dynamic is available for 74.5% of the fatalities. These data are quite complete for GRE (97.4%), CAT (97%) and ITA (96.1%).
- Gender is known for the large majority of FF in TOT-A (78.5%). This information is quite complete for GRE (98.7%), ITA (97.5%), and SFR (95%). Contrary, this information is incomplete for ISR (28.6%).
- Cause of death is available for 80.9% cases of FF in the entire TOT-A. In BAL and GRE, this figure reaches 100% of fatalities, in ITA and SFR, it is around 99.3% of FF.

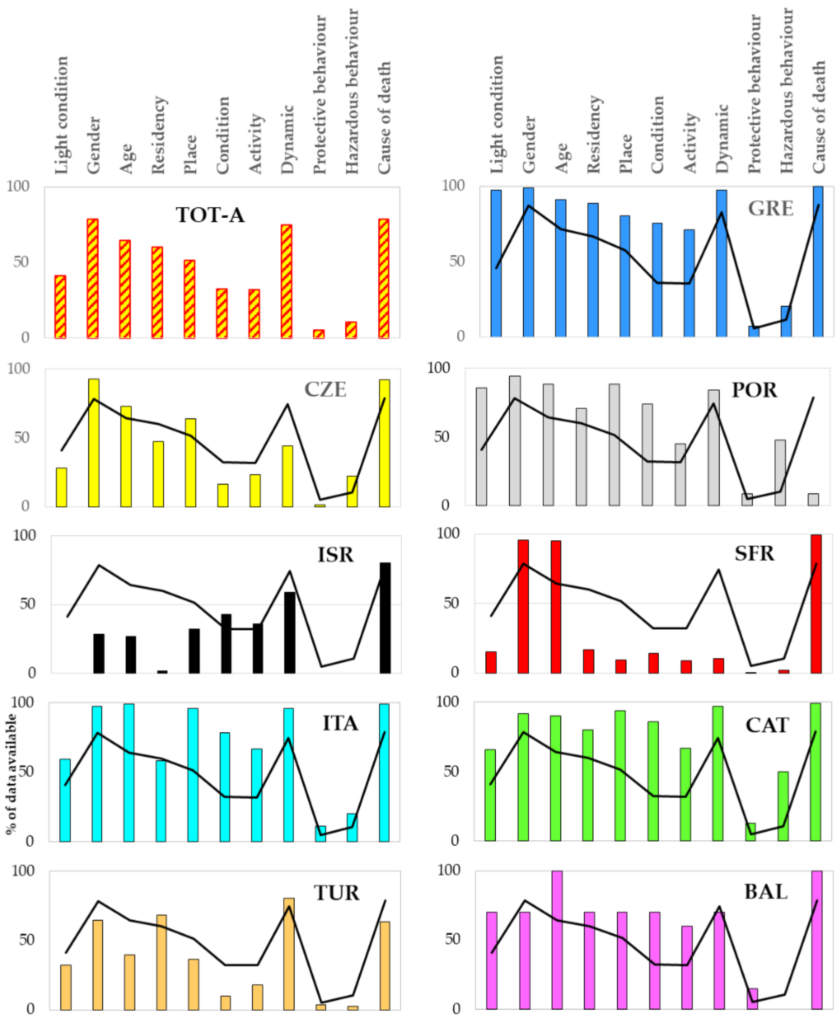

Figure 10. Percentage of data available for each variable in TOT-A, and in each SA.

Despite data uncertainty, that must be taken in account, EUFF database significantly contributes to fill a gap in information on FF on a large scale, in areas where similar databases are not available, and especially covering such a long study period. Particularly, it fills the gap of data on floods causing a number of victims under the threshold to be included in international databases (for EM-DAT, i.e., is 10 people, https://www.emdat.be/). In contrast to international databases that follow a multi-hazard approach, the EUFF only contains FF, not aggregated with fatalities caused by other hazards as lightning, wind, and landslides. This drive to a stricter analysis and affordable results, based on features detected during floods with fatalities. For each victim, the narrative of the event is separated in elementary inputs (fatality age, gender, activity, place, behavior, etc.), and this allows to analyze and assess the relative weight of different features in the fatal events.

4.2. Broader Context and Regional Peculiarities

In EUFF, the majority of FF are males, as obtained in similar studies performed in Switzerland [39], in Europe, USA [40], and in Australia [37,38], showing that males are more exposed to flooding than females. This can depend on two factors: (i) males were more numerous than females in outdoor works, and, until recently, rescue services (e.g., fire fighters, police, and defense forces) consisted entirely of males; (ii) probably, males are most inclined towards risk taking behaviors [19]. Concerning the age of people (majority of adults in working age), it can be explained by similar reasons: people who daily reach the work place are more exposed to floods outdoor, while retired people spent more time at home. Thus, elderly people are more frequently trapped by flood in their home while adults and children are dragged outdoors [41,42].

Compared to EUFF, it appears that in other part of the world the percentage of fatalities by car is higher. The authors of [43], for example, detected 4586 flood fatalities in US between 1959 and 2005, 63% happened in vehicles, while in our database fatalities in vehicles were 19.8% of the total.

For Greece, the flood mortality rates are lower than the average value assessed for TOT-A. However, unlike the average and most EUFF regions, there seems to be quite a strong upward increasing trend in both annual deaths and #FF per event. This may be related to low levels of flood risk awareness and precautionary behaviors among Greek citizens [36,44].

The decrease of FF in Catalonia is due to different factors. Firstly, the frequency of catastrophic floods has decreased in the last decades [45] although this can be part of the natural variability, as has been found for the last 700 years [46]. Secondly, it depends on the significant improvement of risk awareness, preparedness, and emergency management [47] and urbanistic rules that forbid the creation of new urban settlements in flood prone areas. As an example, more than 815 people died in one single event that affected a small region in Catalonia in the nighttime, on 25 September 1962 [48]. A similar pluvial event on 10 June 2000 only killed three people.

In SFR, the evolution of FF is a bit erratic. After a little deadly 1980–1990 decade, the 1990s and beginning of the 2000s were marked by numerous and serious deadly events. This was probably related to an increasing of torrential rain, which affected high-populated sectors. As a result, there was the strengthening of flood prevention with the creation of plans for prevention of risks in 1995 and the enactment of the law risk of July 2003. Mortality was minimal between 2004 and 2009, but serious disasters (as in the departments of Var in 2010, Côte d'Azur in 2015, and Aude in 2018) recently worsen the human toll of floods (more than 10 people per year on average).

More generally, basing on the trend in the study period, SA can be divided in three main groups, according to its annual trends of FF: (i) a downward trend group (CAT, BAL, TUR, POR); an uptrend group (GRE, SFR, ITA); and a stable trend (ISR and CZE). Flood events that generated fatalities are very diverse in the SA without a specific grouping.

Data availability and corresponding features can be gathered in two distinct groups of SA. The first one can be defined as a data scarce context, where more than seven EUFF variables where not available for 50% of FF in a SA. In this group, we include TUR, ISR, SFR and CZE, where the variables that are mostly missing or are scarce correspond to activity, condition, light conditions, protective behavior, and hazard behavior. On contrary, there is a group of SA with a relatively higher amount of data availability (more than 50% of availability per FF variables), including ITA, BAL, CAT, GRE, and POR. In this group, the variables less detailed are protective behavior and hazardous behavior.

Differences can be justified by different climatic characteristics among the SA, which range from Mediterranean climate to temperate and semi-arid climate, which controls the amount and intensity of annual and monthly rainfall distribution and the flood frequency. Additionally, several geomorphological and hydrological factors control the predisposing factors of floods on the field. Other aspects are less controlled by physical constraints, like for instance the hazardous behaviors taken by individuals or stakeholders. And last but not least, the human exposure of flood hazardous zones can be controlled by demographical and economical drivers, but also by the existence/inexistence of spatial planning to avoid hazardous zones.

4.3. Importance of the Study and Future Research

The importance of the paper depends on the significant input to the overview of situations leading to FF in different environmental and cultural frameworks. The impact of this work is in two points:

(a) The presentation and exploitation of the absolutely new and unpublished database, which required strong efforts in terms of coordination and data homogenization;
(b) The results of the paper give original insight into the knowledge of people–flood interaction, which could be used as a building block in increasing resilience campaigns. The results may support educational campaigns tailored to the features really detected and aiming to manage risk and improve people protection in forthcoming floods.

After a long work of data gathering and an intensive phase of their systematization, we created an important source of data, only partially exploited in the present paper. The research will then continue trying to enlarge the total area studied, firstly by adding further countries to the research group, and secondly extending Spanish and French regions to cover the entire countries. Planned activities for the forthcoming of the present research concern further elaboration, both at the scale of the study areas and considering the TOT-A, for the features deserving better understanding, such as the relationship between flood magnitude and number of victims. Further analyses of the historical series collected will highlights major changes in circumstances of fatal events throughout the years, thus supplying a picture of the current frequent situations in which people could be hurt in future events.

In addition, one of the biggest challenges of our research will be to involve indices of wellbeing and economic situation of the various countries involved in the research, to evaluate the hypotheses available in the literature linking these parameters to the vulnerability of people.

5. Conclusions

Between 1980 and 2018, 812 floods killed 2466 people in nine study areas located in Europe. Monthly distribution of both flood events and flood fatalities strictly depends on monthly distribution of rainfall in each study area. In TOT-A, 69% of events occurred between June and November, causing 77% of fatalities. The events exhibit the maximum in October (15%) and a secondary maximum in July (13%). November was the most hazardous month in terms of fatalities (16%).

As a whole, the number of fatalities per event slightly decreased, while the general trend of fatalities seems stable. An increasing trend is observed in Greece, Italy, and South France, especially from 2000 to 2018. This may be due to a combination, in these study areas, of intense floods and low ability of people to react, and can be affected by changes in population density in hazardous areas.

The highest numbers of fatalities were recorded in Turkey (50.4%), Italy (16.5%), and South France (11.1%). By normalizing fatalities to the number of inhabitants of each study area, it appears that South France shows the highest rate, meaning that in this area floods affect the largest percentage of inhabitants with respect to the other study areas. By calculating the flood impact index, taking into account both the number of inhabitants and the density of fatalities normalized to the surface of each study area, we obtained the impact of floods on human lives. This index assumes the highest value for South France followed by Balearic Islands.

The majority of victims were residents in the area of the event. Males were more numerous than females, especially in Czech Republic and Greece. Fatalities were mainly aged between 30 and 49 years, and between 50 years and 64 years. Females were more numerous than males in the age classes <15 years, 15–29 years, and over 65 years. Mortality does not increase with age, neither for males nor for females, while fatalities were more abundant in those parts of the population who were more involved in outdoor activities, related to both work and traveling.

Fatal events occurred more frequently outdoor, and particularly on the roads. The majority of victims, both males and females, were by car or other motor vehicles, traveling/to home/to work when they were dragged by water/mud. It seems that elderly are not particularly vulnerable: the few fatalities over 65 years (1.9%), oppositely to the other classes of age, were mainly killed indoor, blocked in a flooded room, when sleeping.

The primary cause of death was drowning. The second most frequent cause was collapse/heart attack, which was detected in all the classes of ages.

- Protective behaviors, as attempts to get out of car and moving to safer place, were more frequent in female than in males, and mainly in the class 30–49 years, surprisingly followed 0–14 year-old victims.
- Hazardous behaviors, such as fording rivers and staying on riverbanks or bridges, were more frequent in males, but fording rivers were also numerous among females. Fatalities in the ages between 30 and 64 years exhibited all the types of hazardous behaviors identified in this study. Fatalities over 30 also died trying to save cars and belongings, while victims over 50 also refused warning and evacuation. This information confirm the educational importance of this study in prevention of fatal events.

As all the research based on documentary data sources, incompleteness can affect data. The level of detail is strictly related to both age and severity of the events: low-severity events occurred several years ago can be scarcely documented, while more details can be found on severest events recently occurred.

EUFF database represents a unique source of data for the study of floods victims with a broad potential for further spatial and temporal extension for different use, even if some data uncertainty following from the use of documentary data has to be taken into account. The novelty of this study lies in the use of data describing flood fatalities in different countries, allowing to investigate local features governing behavioral choices in the flood–people interactions. Moreover, the study period is long enough to identify trends and perform statistical elaboration. Results can be used for the education of population, teaching to not underestimate the danger of floods and to avoid hazardous behaviors.

Future developments will try to enlarge database by adding further countries. Planned activities concern the analysis of: (i) Relationship between flood magnitude and number of victims; (ii) evolution of circumstances of fatal events throughout the years; and iii) relationships with indices of wellbeing and economic situation of the countries involved in the research, to highlight possible relationships of these parameters with people vulnerability. Resechers who like to contribute to this database can contact us.

Author Contributions: Conceptualization, O.P.; Data curation, L.A., C.B., V.B., A.K., Ö.K., M.L.-B., A.A.P., J.Ř., J.R.G., P.S. and J.L.Z.; Formal analysis, L.A., R.B., S.P., V.K., M.C.L., K.P. and F.V.; Investigation, C.B., V.B., A.K., Ö.K., M.L.-B., A.A.P., J.Ř. and J.R.G.; Methodology, O.P., P.S. and J.L.Z.; Software, L.A.; Validation, R.B., S.P., V.K., M.C.L., K.P. and F.V.; Writing—review and editing, O.P.

Funding: This research received no external funding.

Acknowledgments: This work has been conducted under the framework of the HyMeX Programme (HYdrological cycle in the Mediterranean EXperiment) and the Panta Rhei Group, WG Changes in Flood Risk. Rudolf Brázdil acknowledges support from the Ministry of Education, Youth and Sports of the Czech Republic for the SustES—Adaptation strategies for sustainable ecosystem services and food security under adverse environmental conditions project, no. CZ.02.1.01/0.0/0.0/16_019/0000797. Jan Řehoř was supported by Masaryk University within the MUNI/A/1576/2018 "Complex research of the geographical environment of the planet Earth" project. Susana Pereira and José Luís Zêzere were supported by FCT—Portuguese Foundation for Science and Technology, I.P., under the framework of the project FORLAND—Hydro-geomorphologic risk in Portugal: driving forces and application for land use planning (PTDC/ATPGEO/1660/2014). Maria Carmen Llasat and Montserrat Llasat-Botija acknowledges support from the project M-CostAdapt (CTM2017-83655-C2-2-Ra) of the Spain Ministry of Economy, Industry and Competitiveness.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. EUFF Database: Summary of Data, Light Conditions, Gender, and Age of Fatalities per TOT-A, and per Each SA (the acronyms are the same as in Figure 1. #: Number; %: Percentage). Data available are in bold and percentage in italics.

Variable	TOT-Area		CZE		ISR		ITA		TUR		GRE		POR		SFR		CAT		BAL	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
# Fatalities (#FF)	2466	*100*	142	*5.8*	56	*2.3*	407	*16.5*	1243	*50.4*	156	*6.3*	69	*2.8*	273	*11.1*	100	*4.1*	20	*0.8*
# Fatal events (#EV)	*812*	*100*	67	*8.3*	21	*2.6*	168	*20.7*	325	*40.0*	56	*6.9*	37	*4.6*	86	*10.6*	46	*5.7*	6	*0.7*
Average #FF/#EV	*3.0*		*2.1*		*2.7*		*2.4*		*3.8*		*2.8*		*1.9*		*3.2*		*2.2*		*3.3*	
Average #FF/Year	63.2		3.6		1.4		10.4		31.9		4.0		1.8		7.0		2.6		0.5	
#FF/Area × 1000	1.64		1.80		2.54		1.35		1.59		1.18		0.75		5.07		3.11		4.66	
#FF/Inhabitants × 100,000	1.24		1.35		0.67		0.67		1.52		1.45		0.67		3.77		1.33		1.81	
Total known	1014	*41.1*					242	*59.5*			152	*97.4*			41	*15.0*	66	*66.0*	14	*70.0*
Daylight	380	*15.4*	18	*12.7*	0	—	92	*22.6*	170	*13.7*	38	*24.4*	17	*24.6*	7	*2.6*	38	*38.0*	0	—
Nighttime	475	*19.3*	13	*9.2*	0	—	150	*36.9*	160	*12.9*	47	*30.1*	34	*49.3*	34	*12.5*	23	*23.0*	14	*70.0*
Twilight	159	*6.4*	9	*6.3*	0	—	0	—	70	*5.6*	67	*42.9*	8	*11.6*	0	—	5	*5.0*	0	—
Not reported	1452	*58.9*	102	*71.8*	56	*100.0*	165	*40.5*	843	*67.8*	4	*2.6*	10	*14.5*	232	*85.0*	34	*34.0*	6	*30.0*
Data available	**1014**	***41.1***	**40**	***28.2***	**0**	—	**242**	***59.5***	**400**	***32.2***	**152**	***97.4***	**59**	***85.5***	**41**	***15.0***	**66**	***66.0***	**14**	***70.0***
Total	2466	*100*	142	*100*	56	*100*	407	*100*	1243	*100*	156	*100*	69	*100*	273	*100*	100	*100*	20	*100*
Gender																				
Male	1157	*46.9*	101	*71.1*	13	*23.2*	246	*60.4*	435	*35.0*	107	*68.6*	41	*59.4*	148	*54.2*	58	*58.0*	8	*40.0*
Female	779	*31.6*	31	*21.8*	3	*5.4*	151	*37.1*	370	*29.8*	47	*30.1*	24	*34.8*	113	*41.4*	34	*34.0*	6	*30.0*
Not reported	530	*21.5*	10	*7.0*	40	*71.4*	10	*2.5*	438	*35.2*	2	*1.3*	4	*5.8*	12	*4.4*	8	*8.0*	6	*30.0*
Data available	**1936**	***78.5***	**132**	***93.0***	**16**	***28.6***	**397**	***97.5***	**805**	***64.8***	**154**	***98.7***	**65**	***94.2***	**261**	***95.6***	**92**	***92.0***	**14**	***70.0***
Total	2466	*100*	142	*100*	56	*100*	407	*100*	1243	*100*	156	*100*	69	*100*	273	*100*	100	*100*	20	*100*
Age																				
Child 0–14 years	298	*12.1*	7	*4.9*	2	*3.6*	33	*8.1*	216	*17.4*	5	*3.2*	5	*7.2*	18	*6.6*	11	*11.0*	1	*5.0*
Boy/girl 15–29 years	233	*9.4*	14	*9.9*	1	*1.8*	77	*18.9*	80	*6.4*	15	*9.6*	5	*7.2*	22	*8.1*	16	*16.0*	3	*15.0*
Young adult 30–49 years	371	*15.0*	21	*14.8*	12	*21.4*	110	*27.0*	84	*6.8*	41	*26.3*	8	*11.6*	56	*20.5*	35	*35.0*	4	*20.0*
Adult 50–64 years	320	*13.0*	27	*19.0*	0	—	69	*17.0*	62	*5.0*	46	*29.5*	32	*46.4*	67	*24.5*	12	*12.0*	5	*25.0*
Elderly 65–84 years	319	*12.9*	33	*23.2*	0	—	97	*23.8*	49	*3.9*	33	*21.2*	10	*14.5*	78	*28.6*	13	*13.0*	6	*30.0*
≥85	47	*1.9*	2	*1.4*	0	—	18	*4.4*	1	*0.1*	2	*1.3*	1	*1.4*	19	*7.0*	3	*3.0*	1	*5.0*
Not reported	878	*35.6*	38	*26.8*	41	*73.2*	3	*0.7*	751	*60.4*	14	*9.0*	8	*11.6*	13	*4.8*	10	*10.0*	0	—
Data available	**1588**	***64.4***	**104**	***73.2***	**15**	***26.8***	**404**	***99.3***	**492**	***39.6***	**142**	***91.0***	**61**	***88.4***	**260**	***95.2***	**90**	***90.0***	**20**	***100.0***
Total	2466	*100*	142	*100*	56	*100*	407	*100*	1243	*100*	156	*100*	69	*100*	273	*100*	100	*100*	20	*100*

Table A2. EU FF Database: Residency and Disability of Fatalities and Place of fatal events per TOT-A, and per each SA (#: Number; %: Percentage). Data available are in bold and percentage in italics.

Variable	TOT-Area		CZE		ISR		ITA		TUR		GRE		POR		SFR		CAT		BAL	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Residency																				
Resident	1307	*53.0*	46	*32.4*	0	—	176	*43.2*	821	*66.0*	107	*68.6*	38	*55.1*	37	*13.6*	72	*72.0*	10	*50.0*
Not resident	84	*3.4*	9	*6.3*	0	—	32	*7.9*	13	*1.0*	6	*3.8*	11	*15.9*	7	*2.6*	6	*6.0*	0	—
Tourist	91	*3.7*	12	*8.5*	1	*1.8*	30	*7.4*	15	*1.2*	25	*16.0*	0	—	2	*0.7*	2	*2.0*	4	*20.0*
Not reported	984	*39.9*	75	*52.8*	55	*98.2*	169	*41.5*	394	*31.7*	18	*11.5*	20	*29.0*	227	*83.2*	20	*20.0*	6	*30.0*
Data available	**1482**	***60.1***	**67**	***47.2***	**1**	***1.8***	**238**	***58.5***	**849**	***68.3***	**138**	***88.5***	**49**	***71.0***	**46**	***16.8***	**80**	***80.0***	**14**	***70.0***
Total	2466	*100*	142	*100*	56	*100*	407	*100*	1243	*100*	156	*100*	69	*100*	273	*100*	100	*100*	20	*100*
Disability																				
Not disable/unknown	2412	*97.8*	139	*97.9*	56	*100.0*	393	*96.6*	1236	*99.4*	155	*99.4*	67	*97.1*	255	*93.4*	95	*95.0*	16	*80.0*
Disable	54	*2.2*	3	*2.1*	0	—	14	*3.4*	7	*0.6*	1	*0.6*	2	*2.9*	18	*6.6*	5	*5.0*	4	*20.0*
Total	2466	*100*	142	*100*	56	*100*	407	*100*	1243	*100*	156	*100*	69	*100*	273	*100*	100	*100*	20	*100*
Place																				
Indoor	447	*18.1*	26	*18.3*	0	—	96	*23.6*	247	*19.9*	24	*15.4*	24	*34.8*	15	*5.5*	12	*12.0*	3	*15.0*
Public/private building	447	*18.1*	26	*18.3*	0	—	96	*23.6*	247	*19.9*	24	*15.4*	24	*34.8*	15	*5.5*	12	*12.0*	3	*15.0*
Outdoor	823	*33.4*	65	*45.8*	18	*32.1*	294	*72.2*	204	*16.4*	101	*64.7*	37	*53.6*	11	*4.0*	82	*82.0*	11	*55.0*
Bridge	78	*3.2*	1	*0.7*	0	—	36	*8.8*	17	*1.4*	8	*5.1*	11	*15.9*	0	—	5	*5.0*	0	—
Campsite/tent	19	*0.8*	0	—	0	—	12	*2.9*	7	*0.6*	0	—	0	—	0	—	0	—	0	—
Countryside	59	*2.4*	5	*3.5*	1	*1.8*	11	*2.7*	25	*2.0*	6	*3.8*	3	*4.3*	0	—	8	*8.0*	0	—
Ford	43	*1.7*	0	—	0	—	18	*4.4*	0	—	3	*1.9*	0	—	0	—	22	*22.0*	0	—
Recreation area	3	*0.1*	2	*1.4*	0	—	0	—	0	—	0	—	0	—	0	—	1	*1.0*	0	—
Riverbed/riverside	211	*8.6*	54	*38.0*	10	*17.9*	46	*11.3*	43	*3.5*	16	*10.3*	21	*30.4*	0	—	20	*20.0*	1	*5.0*
Road	404	*16.4*	3	*2.1*	7	*12.5*	167	*41.0*	110	*8.8*	68	*43.6*	2	*2.9*	11	*4.0*	26	*26.0*	10	*50.0*
Tunnel/underpass	6	*0.2*	0	—	0	—	4	*1.0*	2	*0.2*	0	—	0	—	0	—	0	—	0	—
Not reported	1196	*48.5*	51	*35.9*	38	*67.9*	17	*4.2*	792	*63.7*	31	*19.9*	8	*11.6*	247	*90.5*	6	*6.0*	6	*30.0*
Data available	**1270**	***51.5***	**91**	***64.1***	**18**	***32.1***	**390**	***95.8***	**451**	***36.3***	**125**	***80.1***	**61**	***88.4***	**26**	***9.5***	**94**	***94.0***	**14**	***70.0***
Total	2466	*100*	142	*100*	56	*100*	407	*100*	1243	*100*	156	*100*	69	*100*	273	*100*	100	*100*	20	*100*

Table A3. EUFF Database: Condition and Activity of fatalities per TOT-A, and per each SA (#: Number; %: Percentage). Data available are in bold and percentage in italics.

Variable	TOT-Area		CZE		ISR		ITA		TUR		GRE		POR		SFR		CAT		BAL	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Condition																				
By bicycle	9	*0.4*	0	—	0	—	4	*1.0*	1	*0.1*	1	*0.6*	2	*2.9*	1	*0.4*	0	—	0	—
By boat	20	*0.8*	14	*9.9*	0	—	3	*0.7*	0	—	1	*0.6*	0	—	0	—	2	*2.0*	0	—
By bus	46	*1.9*	2	*1.4*	0	—	0	—	39	*3.1*	5	*3.2*	0	—	0	—	0	—	0	—
By car	393	*15.9*	5	*3.5*	8	*14.3*	162	*39.8*	65	*5.2*	59	*37.8*	15	*21.7*	16	*5.9*	53	*53.0*	10	*50.0*
By caravan	6	*0.2*	0	—	0	—	5	*1.2*	0	—	0	—	0	—	1	*0.4*	0	—	0	—
By tractor	15	*0.6*	1	*0.7*	0	—	3	*0.7*	4	*0.3*	3	*1.9*	3	*4.3*	0	—	1	*1.0*	0	—
By truck	22	*0.9*	0	—	0	—	1	*0.2*	11	*0.9*	9	*5.8*	0	—	1	*0.4*	0	—	0	—
By van	7	*0.3*	1	*0.7*	0	—	6	*1.5*	0	—	0	—	0	—	0	—	0	—	0	—
Laying	57	*2.3*	0	—	0	—	13	*3.2*	0	—	8	*5.1*	12	*17.4*	15	*5.5*	7	*7.0*	2	*10.0*
Standing	220	*8.9*	0	—	16	*28.6*	123	*30.2*	0	—	32	*20.5*	19	*27.5*	5	*1.8*	23	*23.0*	2	*10.0*
Not reported	1671	*67.8*	119	*83.8*	32	*57.1*	87	*21.4*	1123	*90.3*	38	*24.4*	18	*26.1*	234	*85.7*	14	*14.0*	6	*30.0*
Data available	**795**	***32.2***	**23**	***16.2***	**24**	***42.9***	**320**	***78.6***	**120**	***9.7***	**118**	***75.6***	**51**	***73.9***	**39**	***14.3***	**86**	***86.0***	**14**	***70.0***
Total	2466	*100*	142	*100*	56	*100*	407	*98*	1243	*100*	156	*100*	69	*100*	273	*100*	100	*100*	20	*100*
Activity																				
Fishing	6	*0.2*	0	—	0	—	5	*1.2*	0	—	1	*0.6*	0	—	0	—	0	—	0	—
Recreational activities	90	*3.6*	12	*8.5*	12	*21.4*	21	*5.2*	14	*1.1*	15	*9.6*	7	*10.1*	1	*0.4*	8	*8.0*	0	—
Rescuing someone	40	*1.6*	6	*4.2*	0	—	15	*3.7*	13	*1.0*	1	*0.6*	1	*1.4*	2	*0.7*	2	*2.0*	0	—
Sleeping	65	*2.6*	0	—	0	—	17	*4.2*	6	*0.5*	8	*5.1*	12	*17.4*	13	*4.8*	7	*7.0*	2	*10.0*
Traveling/to home/to work	445	*18.0*	0	—	8	*14.3*	199	*48.9*	116	*9.3*	62	*39.7*	1	*1.4*	6	*2.2*	43	*43.0*	10	*50.0*
Working	137	*5.6*	15	*10.6*	0	—	16	*3.9*	69	*5.6*	18	*11.5*	10	*14.5*	2	*0.7*	7	*7.0*	0	—
Hunting	6	*0.2*	0	—	0	—	0	—	0	—	6	*3.8*	0	—	0	—	0	—	0	—
Not reported	1677	*68.0*	109	*76.8*	36	*64.3*	134	*32.9*	1025	*82.5*	45	*28.8*	38	*55.1*	249	*91.2*	33	*33.0*	8	*40.0*
Data available	**789**	***32.0***	**33**	***23.2***	**20**	***35.7***	**273**	***67.1***	**218**	***17.5***	**111**	***71.2***	**31**	***44.9***	**24**	***8.8***	**67**	***67.0***	**12**	***60.0***
Total	2466	*100*	142	*100*	56	*100*	407	*100*	1243	*100*	156	*100*	69	*100*	273	*100*	100	*100*	20	*100*

Table A4. EUFF Database: Dynamic and Protective Behavior of fatalities per TOT-A, and per each SA (#: Number; %: Percentage). Data available are in bold and percentage in italics.

Variable	TOT-Area		CZE		ISR		ITA		TUR		GRE		POR		SFR		CAT		BAL	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Dynamic																				
Blocked in a flooded room	192	*7.8*	7	*4.9*	0	—	67	*16.5*	64	*5.1*	21	*13.5*	11	*15.9*	9	*3.3*	10	*10.0*	3	*15.0*
Caught in a bridge collapse	54	*2.2*	2	*1.4*	0	—	30	*7.4*	12	*1.0*	6	*3.8*	1	*1.4*	0	—	3	*3.0*	0	—
Caught in a road collapse	25	*1.0*	1	*0.7*	0	—	21	*5.2*	0	—	0	—	0	—	2	*0.7*	1	*1.0*	0	—
Caught in building collapse	200	*8.1*	8	*5.6*	0	—	2	*0.5*	186	*15.0*	1	*0.6*	1	*1.4*	0	—	2	*2.0*	0	—
Dragged by water/mud	1231	*49.9*	12	*8.5*	28	*50.0*	227	*55.8*	713	*57.4*	113	*72.4*	41	*59.4*	14	*5.1*	72	*72.0*	11	*55.0*
Fallen into the river	88	*3.6*	28	*19.7*	4	*7.1*	27	*6.6*	20	*1.6*	3	*1.9*	2	*2.9*	0	—	4	*4.0*	0	—
Surrounded by water/mud	34	*1.4*	0	—	1	*1.8*	15	*3.7*	2	*0.2*	8	*5.1*	2	*2.9*	1	*0.4*	5	*5.0*	0	—
Hit	14	*0.6*	5	*3.5*	0	—	2	*0.5*	5	*0.4*	0	—	0	—	2	*0.7*	0	—	0	—
Not reported	628	*25.5*	79	*55.6*	23	*41.1*	16	*3.9*	241	*19.4*	4	*2.6*	11	*15.9*	245	*89.7*	3	*3.0*	6	*30.0*
Data available	**1838**	***74.5***	**63**	***44.4***	**33**	***58.9***	**391**	***96.1***	**1002**	***80.6***	**152**	***97.4***	**58**	***84.1***	**28**	***10.3***	**97**	***97.0***	**14**	***70.0***
Total	2466	*100*	142	*100*	56	*100*	407	*100*	1243	*100*	156	*100*	69	*100*	273	*100*	100	*100*	20	*100*
Protective Behaviour																				
Climbing trees	5	*0.2*	0	—	0	—	4	*1.0*	1	*0.1*	0	—	0	—	0	—	0	—	0	—
Driving to avoid danger	2	*0.1*	0	—	0	—	1	*0.2*	0	—	0	—	0	—	0	—	1	*1.0*	0	—
Getting on roof/upper floor	2	*0.1*	0	—	0	—	2	*0.5*	0	—	0	—	0	—	0	—	0	—	0	—
Getting out of buildings	9	*0.4*	0	—	0	—	0	—	3	*0.2*	0	—	3	*4.3*	0	—	3	*3.0*	0	—
Getting out of cars	62	*2.5*	0	—	0	—	25	*6.1*	12	*1.0*	10	*6.4*	3	*4.3*	1	*0.4*	8	*8.0*	3	*15.0*
Grabbing on to someone/something	6	*0.2*	0	—	0	—	2	*0.5*	1	*0.1*	0	—	2	*2.9*	0	—	1	*1.0*	0	—
Moving to safer place	44	*1.8*	2	*1.4*	0	—	13	*3.2*	27	*2.2*	1	*0.6*	0	—	0	—	1	*1.0*	0	—
Not reported	2336	*94.7*	140	*98.6*	56	*100.0*	360	*88.5*	1199	*96.5*	145	*92.9*	61	*88.4*	272	*99.6*	86	*86.0*	17	*85.0*
Data available	**130**	*5.3*	**2**	*1.4*	**0**	—	**47**	*11.5*	**44**	*3.5*	**11**	*7.1*	**8**	*11.6*	**1**	*0.4*	**14**	*14.0*	**3**	*15.0*
Total	2466	*100.0*	142	*100*	56	*100*	407	*100*	1243	*100*	156	*100*	69	*100*	273	*100*	100	*100*	20	*100*

Table A5. EUFF Database: Hazardous Behavior and Cause of Death of fatalities per TOT-A, and per each SA (#: Number; %: Percentage). Data available are in bold and percentage in italics.

Variable	TOT-Area		CZE		ISR		ITA		TUR		GRE		POR		SFR		CAT		BAL	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Hazardous Behaviour																				
Check damage during the event	12	*0.5*	1	*0.7*	0	—	1	*0.2*	2	*0.2*	1	*0.6*	3	*4.3*	1	*0.4*	3	*3.0*	0	—
Driving on a road close by police	9	*0.4*	1	*0.7*	0	—	2	*0.5*	0	—	2	*1.3*	0	—	1	*0.4*	3	*3.0*	0	—
Fording rivers	95	*3.9*	0	—	0	—	42	*10.3*	5	*0.4*	14	*9.0*	2	*2.9*	0	—	32	*32.0*	0	—
Refuse evacuation	5	*0.2*	2	*1.4*	0	—	0	—	0	—	0	—	0	—	2	*0.7*	1	*1.0*	0	—
Refuse warnings	24	*1.0*	18	*12.7*	0	—	0	—	0	—	0	—	5	*7.2*	0	—	1	*1.0*	0	—
Staying on bridges during floods	25	*1.0*	2	*1.4*	0	—	0	—	0	—	10	*6.4*	10	*14.5*	0	—	3	*3.0*	0	—
Staying on river banks	40	*1.6*	4	*2.8*	0	—	18	*4.4*	1	*0.1*	1	*0.6*	12	*17.4*	0	—	4	*4.0*	0	—
Trying to rescue animals	16	*0.6*	0	—	0	—	5	*1.2*	7	*0.6*	2	*1.3*	1	*1.4*	1	*0.4*	0	—	0	—
Trying to save belongings	19	*0.8*	2	*1.4*	0	—	4	*1.0*	8	*0.6*	2	*1.3*	0	—	0	—	3	*3.0*	0	—
Trying to save vehicles	17	*0.7*	2	*1.4*	0	—	11	*2.7*	4	*0.3*	0	—	0	—	0	—	0	—	0	—
Not reported	2204	*89.4*	110	*77.5*	56	*100.0*	324	*79.6*	1216	*97.8*	124	*79.5*	36	*52.2*	268	*98.2*	50	*50.0*	20	*100.0*
Data available	**262**	***10.6***	**32**	***22.5***	**0**	—	**83**	***20.4***	**27**	***2.2***	**32**	***20.5***	**33**	***47.8***	**5**	***1.8***	**50**	***50.0***	**0**	—
Total	2466	*100*	142	*100*	56	*100*	407	*100*	1243	*100*	156	*100*	69	*100*	273	*100*	100	*100*	20	*100*
Cause of Death																				
Collapse/Heart attack	237	*9.6*	12	*8.5*	0	—	15	*3.7*	189	*15.2*	3	*1.9*	2	*2.9*	15	*5.5*	1	*1.0*	0	—
Drowning	1693	*68.7*	105	*73.9*	45	*80.4*	366	*89.9*	670	*53.9*	140	*89.7*	6	*8.7*	248	*90.8*	94	*94.0*	19	*95.0*
Hypothermia	6	*0.2*	2	*1.4*	0	—	1	*0.2*	0	—	2	*1.3*	0	—	1	*0.4*	0	—	0	—
Poly-trauma	25	*1.0*	8	*5.6*	0	—	5	*1.2*	0	—	3	*1.9*	0	—	5	*1.8*	3	*3.0*	1	*5.0*
Poly-trauma and Suffocation	29	*1.2*	4	*2.8*	0	—	16	*3.9*	0	—	8	*5.1*	0	—	0	—	1	*1.0*	0	—
Suffocation	3	*0.1*	1	*0.7*	0	—	0	—	0	—	0	—	0	—	2	*0.7*	0	—	0	—
Electrocution	1	*0.0*	0	—	0	—	1	*0.2*	0	—	0	—	0	—	0	—	0	—	0	—
Not reported	472	*19.1*	10	*7.0*	11	*19.6*	3	*0.7*	384	*30.9*	0	—	61	*88.4*	2	*0.7*	1	*1.0*	0	—
Data available	**1994**	***80.9***	**132**	***93.0***	**45**	***80.4***	**404**	***99.3***	**859**	***69.1***	**156**	***100.0***	**8**	***11.6***	**271**	***99.3***	**99**	***99.0***	**20**	***100.0***
Total	2466	*100*	142	*100*	56	*100*	407	*100*	1243	*100*	156	*100*	69	*100*	273	*100*	100	*100*	20	*100*

References

1. United Nations. *General Assembly*; Oxford Handbook United Nations: New York, NY, USA, 2009; pp. 1–15.
2. Diakakis, M. Have flood mortality qualitative characteristics changed during the last decades? The case study of Greece. *Environ. Hazards* **2016**, *15*, 148–159. [CrossRef]
3. Pereira, S.; Zêzere, J.L.; Quaresma, I.; Santos, P.P.; Santos, M. Mortality Patterns of Hydro-Geomorphologic Disasters. *Risk Anal.* **2016**, *36*, 1188–1210. [CrossRef] [PubMed]
4. Onuma, H.; Shin, K.J.; Managi, S. Reduction of future disaster damages by learning from disaster experiences. *Nat. Hazards* **2017**, *87*, 1435–1452. [CrossRef]
5. Wu, J.; Li, Y.; Ye, T.; Li, N. Changes in mortality and economic vulnerability to climatic hazards under economic development at the provincial level in China. *Reg. Environ. Chang.* **2019**, *19*, 125–136. [CrossRef]
6. Jongman, B.; Winsemius, H.C.; Aerts, J.C.J.H.; Coughlan de Perez, E.; van Aalst, M.K.; Kron, W.; Ward, P.J. Declining vulnerability to river floods and the global benefits of adaptation. *Proc. Natl. Acad. Sci. USA* **2015**, *112*, E2271–E2280. [CrossRef] [PubMed]
7. Field, C.B.; Barros, V.; Stocker, T.F.; Dahe, Q.; Jon Dokken, D.; Ebi, K.L.; Mastrandrea, M.D.; Mach, K.J.; Plattner, G.K.; Allen, S.K.; et al. *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation: Special Report of the Intergovernmental Panel on Climate Change*; Cambridge University Press: Cambridge, UK, 2012; Volume 9781107025, ISBN 9781139177245.
8. Di Baldassarre, G.; Kreibich, H.; Vorogushyn, S.; Aerts, J.; Arnbjerg-Nielsen, K.; Barendrecht, M.; Bates, P.; Borga, M.; Botzen, W.; Bubeck, P.; et al. Hess opinions: An interdisciplinary research agenda to explore the unintended consequences of structural flood protection. *Hydrol. Earth Syst. Sci.* **2018**, *22*, 5629–5637. [CrossRef]
9. Peden, A.E.; Franklin, R.C.; Leggat, P.A. Fatal river drowning: The identification of research gaps through a systematic literature review. *Inj. Prev.* **2016**, *22*, 202–209. [CrossRef]
10. Sharif, H.O.; Hossain, M.M.; Jackson, T.; Bin-Shafique, S. Person-place-time analysis of vehicle fatalities caused by flash floods in Texas. *Geomat. Nat. Hazards Risk* **2012**, *3*, 311–323. [CrossRef]
11. Hamilton, K.; Peden, A.E.; Keech, J.J.; Hagger, M.S. Changing people's attitudes and beliefs toward driving through floodwaters: Evaluation of a video infographic. *Transp. Res. Part F Traffic Psychol. Behav.* **2018**, *53*, 50–60. [CrossRef]
12. Milanesi, L.B.B.; Pilotti, M. Water Resources Research. *J. Am. Water Resour. Assoc.* **2016**, *5*, 2.
13. Ma, M.; He, B.; Wan, J.; Jia, P.; Guo, X.; Gao, L.; Maguire, L.W.; Hong, Y. Characterizing the flash flooding risks from 2011 to 2016 over China. *Water* **2018**, *10*, 704. [CrossRef]
14. Paul, S.; Sharif, H.; Crawford, A. Fatalities Caused by Hydrometeorological Disasters in Texas. *Geosciences* **2018**, *8*, 186. [CrossRef]
15. Shah, V.; Kirsch, K.R.; Cervantes, D.; Zane, D.F.; Haywood, T.; Horney, J.A. Flash flood swift water rescues, Texas, 2005–2014. *Clim. Risk Manag.* **2017**, *17*, 11–20. [CrossRef]
16. Peden, A.E.; Franklin, R.C.; Leggat, P. The Flood-Related Behaviour of River Users in Australia. *PLoS Curr.* **2018**, *10*, 1–12. [CrossRef] [PubMed]
17. Hamilton, K.; Peden, A.E.; Pearson, M.; Hagger, M.S. Stop there's water on the road! Identifying key beliefs guiding people's willingness to drive through flooded waterways. *Saf. Sci.* **2016**, *89*, 308–314. [CrossRef]
18. Petrucci, O.; Papagiannaki, K.; Aceto, L.; Boissier, L.; Kotroni, V.; Grimalt, M.; Llasat, M.C.; Llasat-Botija, M.; Rosselló, J.; Pasqua, A.A.; et al. MEFF: The database of MEditerranean Flood Fatalities (1980 to 2015). *J. Flood Risk Manag.* **2019**, *12*, 1–17. [CrossRef]
19. Salvati, P.; Petrucci, O.; Rossi, M.; Bianchi, C.; Pasqua, A.A.; Guzzetti, F. Gender, age and circumstances analysis of flood and landslide fatalities in Italy. *Sci. Total Environ.* **2018**, *610*, 867–879. [CrossRef]
20. Petrucci, O.; Salvati, P.; Aceto, L.; Bianchi, C.; Pasqua, A.; Rossi, M.; Guzzetti, F. The Vulnerability of People to Damaging Hydrogeological Events in the Calabria Region (Southern Italy). *Int. J. Environ. Res. Public Health* **2017**, *15*, 48. [CrossRef]
21. Aceto, L.; Aurora Pasqua, A.; Petrucci, O. Effects of damaging hydrogeological events on people throughout 15 years in a Mediterranean region. *Adv. Geosci.* **2017**, *44*, 67–77. [CrossRef]
22. Kahraman, A.; Tilev-Tanriover, Ş.; Kadioglu, M.; Schultz, D.M.; Markowski, P.M. Severe Hail Climatology of Turkey. *Mon. Weather Rev.* **2015**, *144*, 337–346. [CrossRef]

23. Kahraman, A.; Markowski, P.M. Tornado Climatology of Turkey. *Mon. Weather Rev.* **2014**, *142*, 2345–2352. [CrossRef]
24. Tilev-Tanriover, Ş.; Kahraman, A.; Kadioğlu, M.; Schultz, D.M. Lightning fatalities and injuries in Turkey. *Nat. Hazards Earth Syst. Sci.* **2015**, *15*, 1881–1888. [CrossRef]
25. Papagiannaki, K.; Lagouvardos, K.; Kotroni, V. A database of high-impact weather events in Greece: A descriptive impact analysis for the period 2001–2011. *Nat. Hazards Earth Syst. Sci.* **2013**, *13*, 727–736. [CrossRef]
26. Zêzere, J.L.; Pereira, S.; Tavares, A.O.; Bateira, C.; Trigo, R.M.; Quaresma, I.; Santos, P.P.; Santos, M.; Verde, J. DISASTER: A GIS database on hydro-geomorphologic disasters in Portugal. *Nat. Hazards* **2014**, *72*, 503–532. [CrossRef]
27. Pereira, S.; Diakakis, M.; Deligiannakis, G.; Zêzere, J.L. Comparing flood mortality in Portugal and Greece (Western and Eastern Mediterranean). *Int. J. Disaster Risk Reduct.* **2017**, *22*, 147–157. [CrossRef]
28. Boissier, L. La Mortalité liée aux crues Torrentielles dans le sud de la France: Une Approche de la Vulnérabilité Humaine face à L'inondation. Ph.D. Thesis, Paul Valéry Montpellier, Montpellier, France, 2013.
29. Vinet, F.; Boissier, L. Flashflood-related mortality in southern France: First results from a new database. *E3S Web Conf.* **2016**, *7*, 06001. [CrossRef]
30. Llasat, M.C.; Marcos, R.; Llasat-Botija, M.; Gilabert, J.; Turco, M.; Quintana-Seguí, P. Flash flood evolution in North-Western Mediterranean. *Atmos. Res.* **2014**, *149*, 230–243. [CrossRef]
31. Grimalt Gelabert, M. *Geografia del risc a Mallorca: Les inundacions/Miquel Grimalt i Gelabert*; Institut d'Estudis Balearics: Palma de Mallorca, Spain, 1992.
32. Petrucci, O.; Polemio, M.; Pasqua, A.A. Analysis of damaging hydrogeological events: The case of the calabria region (Southern Italy). *Environ. Manag.* **2009**, *43*, 483–495. [CrossRef]
33. Petrucci, O.; Pasqua, A.A. *Landslide Science and Practice*; Springer: Berlin, Germany, 2013; Volume 7, ISBN 9783642313134.
34. Tolasz, R.; Míková, T.; Valeriánová, A.; Voženílek, V. *Climate Atlas of Czechia*; Czech Hydrometeorological Institute: Praha, Czech Republic; Palacký University: Olomouc, Czech Republic, 2007.
35. McGhee, G.; Marland, G.R.; Atkinson, J. Grounded theory research: Literature reviewing and reflexivity. *J. Adv. Nurs.* **2007**, *60*, 334–342. [CrossRef]
36. Papagiannaki, K.; Kotroni, V.; Lagouvardos, K.; Ruin, I.; Bezes, A. Urban Area Response to Flash Flood–Triggering Rainfall, Featuring Human Behavioral Factors: The Case of 22 October 2015 in Attica, Greece. *Weather. Clim. Soc.* **2017**, *9*, 621–638. [CrossRef]
37. Coates, L. Flood fatalities in Australia, 1788–1996. *Aust. Geogr.* **1999**, *30*, 391–408. [CrossRef]
38. Fitzgerald, G.; Du, W.; Jamal, A.; Clark, M.; Hou, X.Y. Flood fatalities in contemporary Australia (1997-2008): Disaster medicine. *EMA Emerg. Med. Australas.* **2010**, *22*, 180–186. [PubMed]
39. Badoux, A.; Andres, N.; Techel, F.; Hegg, C. Natural hazard fatalities in Switzerland from 1946 to 2015. *Nat. Hazards Earth Syst. Sci.* **2016**, *16*, 2747–2768. [CrossRef]
40. Jonkman, S.N.; Kelman, I. An analysis of the causes and circumstances of flood disaster deaths. *Disasters* **2005**, *29*, 75–97. [CrossRef] [PubMed]
41. Vinet, F. Flood Impacts on Loss of Life and Human Health. In *Floods*; Elsevier: London, UK, 2017; pp. 33–51.
42. Haynes, K.; Coates, L.; van den Honert, R.; Gissing, A.; Bird, D.; de Oliveira, F.D.; D'Arcy, R.; Smith, C.; Radford, D. Exploring the circumstances surrounding flood fatalities in Australia—1900–2015 and the implications for policy and practice. *Environ. Sci. Policy* **2017**, *76*, 165–176. [CrossRef]
43. Ashley, S.T.; Ashley, W.S. Flood fatalities in the United States. *J. Appl. Meteorol. Climatol.* **2008**, *47*, 805–818. [CrossRef]
44. Papagiannaki, K.; Kotroni, V.; Lagouvardos, K.; Papagiannakis, G. How awareness and confidence affect flood-risk precautionary behavior of Greek citizens: The role of perceptual and emotional mechanisms. *Nat. Hazards Earth Syst. Sci. Discuss.* **2018**, *19*, 1329–1346. [CrossRef]
45. Llasat, M.C.; Marcos, R.; Turco, M.; Gilabert, J.; Llasat-Botija, M. Trends in flash flood events versus convective precipitation in the Mediterranean region: The case of Catalonia. *J. Hydrol.* **2016**, *541*, 24–37. [CrossRef]
46. Barrera-Escoda, A.; Llasat, M.C. Evolving flood patterns in a Mediterranean region (1301–2012) and climatic factors - The case of Catalonia. *Hydrol. Earth Syst. Sci.* **2015**, *19*, 465–483. [CrossRef]

47. Kreibich, H.; Di Baldassarre, G.; Vorogushyn, S.; Aerts, J.C.J.H.; Apel, H.; Aronica, G.T.; Arnbjerg-Nielsen, K.; Bouwer, L.M.; Bubeck, P.; Caloiero, T.; et al. Adaptation to flood risk: Results of international paired flood event studies. *Earth's Future* **2017**, *5*, 953–965. [CrossRef]
48. Martín-Vide, J.P.; Llasat, M.C. The 1962 flash flood in the Rubí stream (Barcelona, Spain). *J. Hydrol.* **2018**, *566*, 441–454. [CrossRef]

© 2019 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (http://creativecommons.org/licenses/by/4.0/).