

Spatial and Temporal Distribution of Natural Disasters - Empirical Evidence

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**SPATIAL AND TEMPORAL DISTRIBUTION OF GEOPHYSICAL
DISASTERS***Vladimir Cvetković*^{*1}, *Saša Mijalković*^{*}^{*} The Academy of Criminalistic and Police Studies, Belgrade

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Abstract: Natural disasters of all kinds (meteorological, hydrological, geophysical, climatological and biological) are increasingly becoming part of everyday life of modern human. The consequences are often devastating, to the life, health and property of people, as well to the security of states and the entire international regions. In this regard, we noted the need for a comprehensive investigation of the phenomenology of natural disasters. In addition, it is particularly important to pay attention to the different factors that might correlate with each other to indicate more dubious and more original facts about their characteristics. However, as the issue of natural disasters is very wide, the subject of this paper will be forms, consequences, temporal and spatial distribution of geophysical natural disasters, while analysis of other disasters will be the subject of our future research. Using an international database on natural disasters of the centre for research on the epidemiology of disasters (CRED) based in Brussels, with the support of the statistical analysis (SPSS), we tried to point out the number, trends, consequences, the spatial and temporal distribution of earthquakes, volcanic eruptions and dry mass movements in the world, from 1900 to 2013.

Key words: geophysical disasters, statistical analysis, earthquake, volcanic eruptions, mass movement dry.

Introduction

Natural disasters are catastrophic events resulting from natural hazards. They result from internal (beneath the Earth's surface), external (topographical), weather-related (meteorological/hydrological) and biological phenomena (Eshghi & Larson, 2008:65). Natural disasters are beyond human control and they are often termed an "Act of God" (Shaluf, 2007:687).

Natural disasters are naturally occurring physical phenomena caused either by rapid or slow onset events which can be geophysical (earthquakes, landslides, volcanic activity), hydrological (avalanches and floods), climatological (extreme temperatures, drought and wildfires), meteorological (cyclones and storms/wave

1 Correspondence to: vladimir.cvetkovic@kpa.edu.rs

surges) or biological (disease epidemics and insect/animal plagues) (Edward, 2005:78; Mijalković, 2011:195-197).

CRED defines a disaster as "a situation or event which overwhelms local capacity, necessitating a request to a national or international level for external assistance; an unforeseen and often sudden event that causes great damage, destruction and human suffering" (Guha, Vos, Below & Ponserre, 2012:15). They are a consequence of mutual influence of natural events (geophysical processes and other processes in nature) and human systems (social - economic, cultural and physical) (Mladen & Cvetković, 2013).

These are events that have a major and tragic impact on society, undermine the common ways of life, hinder economic, cultural, and sometimes political conditions of life and slow down the development of the community and require special measures by emergency and rescue services in emergency situations (Cvetković, 2013:9). The consequences can be reflected not only in the national but also at regional and global level of security (Mijalković, 2009:69-83).

Table 1. Overview of the world's natural disasters in the period from 1900 to 2013

Disaster sub-group	Occurrence	No. of people killed	No. of people injured	No. of people affected	Homeless	Total affected	Estimated damage (\$)
Meteorological	7149	2766859	2641153	1742924832	105054916	1850620901	1872273246
Geophysical	3037	5331007	5177147	309279694	45930226	360387067	1522543792
Hydrological	9557	13987140	2655118	6891172180	185223183	7079050481	1200003042
Biological	2820	19152311	968153	90325323	0	91293476	460264
Climatological	2989	23772449	3779656	4532945549	903962	4537629167	471765608
Total	25552	65009766	15221227	13566647578	337112287	13918981092	5067045952

Source of data: EM-DAT: The OFDA/CRED International Disaster Database

During the period from 1900 to 2013 there have been 25.552 natural disasters. Out of these, most disasters were hydrological, then meteorological, geophysical, climatological and biological ones (Table 1). Since this is a really extensive matter, the subject of this paper will analyze forms of expression, number, and the result of temporal and geographical propagation of a geophysical disasters. Phenomenology of other types of disasters will be the subject of our future research.

Methodology

The research was conducted on the basis of a very extensive research of the center for epidemiology disasters (CRED), in such a way that raw data were retrieved on July 8, 2013 from the international database on disasters at www.emdat.be. For a disaster to be entered into the database, at least one of the following criteria must be fulfilled: 10 or more people reported killed; 100 or

more people reported affected; announcement of a state of emergency; call for international assistance (Gyha, et al., 2012:15). The raw data have been taken in the form of an Excel file with 25.552 registered events. Such - raw data were further processed by the statistical analysis of data IBM SPSS Advanced Statistics 20.0., in a such a way that data auto recoding was first made: transform → automatic recode →variable → new name→ ok; After that, recoding data is completed: Transform → Recode into different variables →variable → new name→ old and new values → ok, frequencies and percentages of summary variables are calculated: analyze → descriptive statistics → frequencies → variables → ok. Lastly, tables and charts are made. Results of the processing of these data are shown in the text, tables and graphs.

The meanings of terms that are used in this work are: killed - number of people confirmed dead and number of missing and presumed dead; injured - number of people suffering from physical injuries, trauma or an illness requiring immediate medical treatment as a direct result of a disaster; homeless - number of people needing immediate assistance for shelter; affected - number of people requiring immediate assistance during a period of emergency; this may include displaced or evacuated people; total affected - sum of injured, homeless and affected; estimated damage (\$) - global figure of the economic impact of a disaster; it is given in US dollars (Guha, et al. 2012:16).

Geophysical disasters

Geophysical disasters are earthquakes, volcanic eruptions and mass movements dry (Shaluf, Ahmadun & Said, 2003:27). Compared to other types of natural disasters, according to its frequency in the period from 1900 to 2013, they occupy the third place with 11.89% (Figure 1).

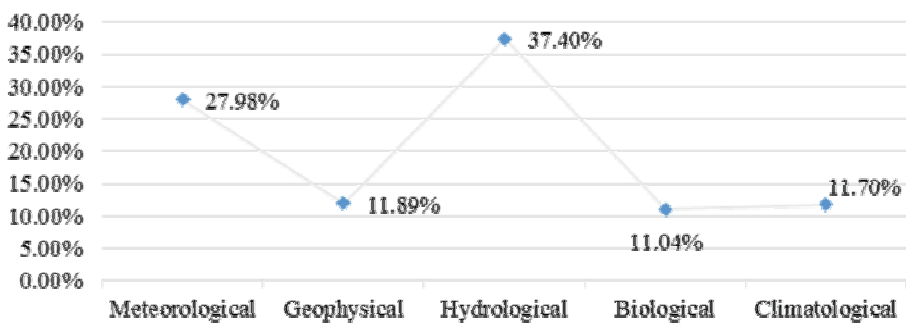


Figure 1. Percentage of the total number of natural disasters in the period from 1900 to 2013. Source of data: EM-DAT: The OFDA/CRED International Disaster Database

By the consequences in terms of the number of people killed, geophysical disasters are in fourth place with 20.8%. By the number of injured people, they are in the first place with 34.01%, while by the number of affected they are in the fourth place with 2.28%. Given the number of people left homeless due to natural disasters, geophysical disasters are in third place with 13.62% (Figure 2).

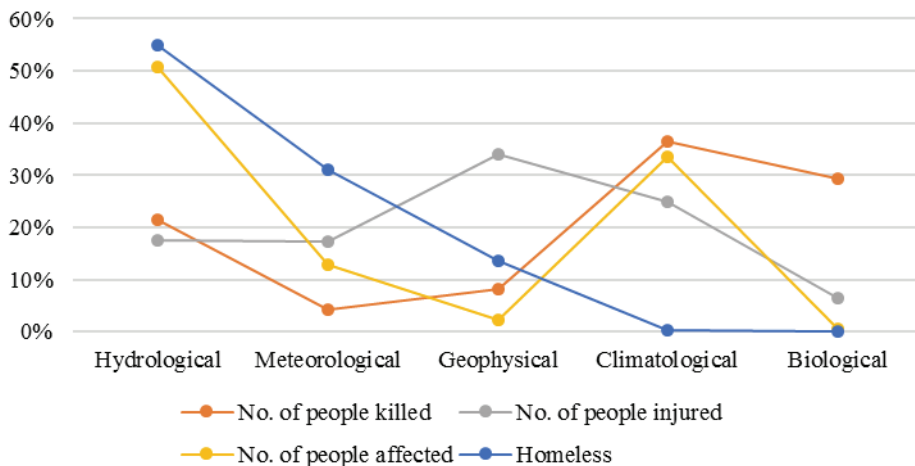


Figure 2. Percentage of consequences of all kinds of natural disasters to people in the period from 1900 to 2013. Source of data: EM-DAT: The OFDA/CRED International Disaster Database

Table 2. Review of total number and consequences of geophysical disasters in the period from 1900 to 2013

Disaster main type	Occurrence	No. of people killed	No. of people injured	No. of people affected	Homeless	Total affected	Estimated damage (\$)
Earthquake	2475	5128349	5152887	299445174	45166684	349764745	1515959896
Mass movement	110	10034	1022	45376	11962	58360	503200
dry							
Volcanic eruptions	452	192624	23238	9789114	751580	10563962	6080696
Total	3037	5331007	5177147	309279664	45930226	360387067	1522543792
Annually	27	47177	45815	2736988	406462	3189266	13473838
Monthly	2	3931	3817	228082	33871	265772	1122819
Daily	0.07	131	127	7602	1129	8859	37427

Source of data: EM

DAT: The OFDA/CRED International Disaster

Source of data: EM-DAT: The OFDA/CRED International Disaster Database

During the period from 1900 to 2013, there were 3.037 geophysical disasters. Their consequences are 5.331.007 killed, 5.177.147 injured, 309.279.664 affected and 45.930.226 homeless. Thus, the total number of affected people was 349.764.745. Total estimated damage amounted to 1.515.959.896 U.S. dollars. On average, there were 27 geophysical disasters annually, 2 monthly, 0.07 daily (Table 2). In percentage terms, out of total number of geophysical disasters,

earthquakes make 81.49%, volcanic eruptions 14.88% and mass movement dry 3.62% (Figure 3)

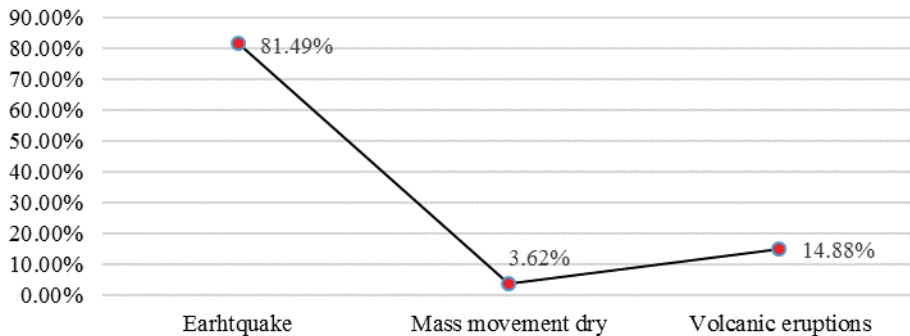


Figure 3. Percentage overview of the total number of geophysical disasters in the period from 1900 to 2013. Source of data: EM-DAT: The OFDA/CRED International Disaster Database

Earthquake

An earthquake is a sudden, intense shaking of the earth's crust caused by the breaking and shifting of rock beneath the Earth (Haddow, Bullock & Copola, 2011:87). That is a sudden break within the upper layers of the earth, sometimes breaking the surface, resulting in the vibration of the ground, which, when strong enough, will cause the collapse of buildings and destruction of life and property (Davis, 2008:36).

Table 3. Review of total number and consequences of earthquakes in the period from 1900 to 2013, with regard to the average annual, monthly and daily distribution

Period	Occurrence	No. of people killed	No. of people injured	No. of people affected	Homeless	Total affected	Estimated damage (\$)
1900-2013	2475	5128349	5152887	299445174	45166684	349764745	1515959896
Total	2475	5128349	5152887	299445174	45166684	349764745	1515959896
Annually	22	45384	45601	2649957	399705	3095263	13415574
Monthly	1,8	3781	3800	220829	33308	257938	1117964
Daily	0,06	126	125	7260	1095	8480	37265

Source of data: EM-DAT: The OFDA/CRED International Disaster Database

During the period from 1900 to 2013, there were 2.475 earthquakes. Their consequences are 5.128.349 killed, 5.152.887 injured, 299.445.174 affected and 45.166.684 homeless. Thus, the total number of affected people was 349.764.745. Total estimated damage amounted to 1.515.959.896 U.S. dollars. On average, there were 22 earthquakes annually, 1,8 monthly, 0.06 daily (Table 3).

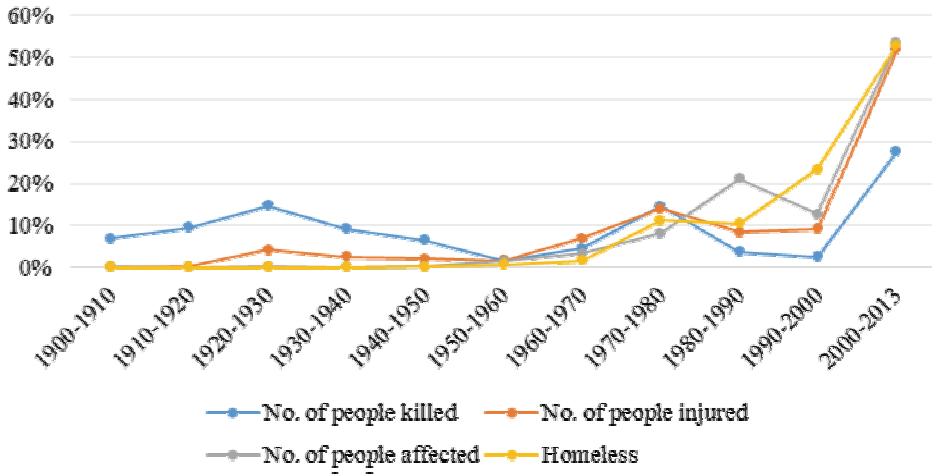


Figure 4. Percentage review of the effects of earthquakes on humans in the period from 1900 to 2013. Source of data: EM-DAT: The OFDA/CRED International Disaster Database

In terms of percentage, as a consequence of an earthquake, most people were killed (27,38%), injured (51,77%), affected (53,30%) and made homeless (52,75%) in the period from 2000 to 2013. There were least killed as a consequence of an earthquake (1,44%) in the period from 1900-1910, least injured (0%) in the period from 1900-1910, affected (0%) in the period from 1910-1920, and least people made homeless (0%) from 1900 to 1910, and 1910 to 1920 (Figure 4).

Table 4. Review of total numbers and consequences of earthquakes in the period from 1900 to 2013, classified by continents

Continent	Occurrence	No. of people killed	No. of people injured	No. of people affected	Homeless	Total affected	Estimated damage (\$)
Asia	1354	3643557	3399525	231408080	31815436	266623041	1080558376
Americas	538	878596	1517776	56826052	8733946	67077774	202871612
Europe	321	556598	107970	8171412	2746074	11025456	155732672
Africa	158	42772	121236	1655876	1830988	3608100	24719398
Oceania	104	6826	6380	1383754	40240	1430374	52077838
Total	2475	5128349	5152887	299445174	45166684	349764745	1515959896

Source of data: EM-DAT: The OFDA/CRED International Disaster Database

Most earthquakes occurred in Asia 1.354, and least in Oceania 104. Thus, by the number of earthquakes the first is Asia, then Americas, Europe, Africa and Oceania at the end (Table 4).

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Table 5. Top 5 countries by number of earthquakes in the period from 1900 to 2013

Country	Occurrence	No. of people killed	No. of people injured	No. of people affected	Homeless	Total affected	Estimated damage (\$)
China	277	1751161	1308165	132365104	9032350	142705619	200231414
Indonesia	223	396896	337844	14664738	3113096	18115678	23131852
Iran	206	294932	344904	4503188	507430	5355522	22037256
Turkey	152	178472	194578	11262522	2390910	13848010	49370800
Japan	115	388740	314246	1882986	588240	2785472	719324800

Source of data: EM-DAT: The OFDA/CRED International Disaster Database

Most earthquakes occurred in China - 277, then in Indonesia - 223, Iran - 206, Turkey - 152 and Japan - 115. However, in addition to this, it is necessary to note that the most people were killed in earthquakes in China - 1.751.161 but it is also the largest number of injured people that was in China - 1.308.165 (Table 5).

Table 6. Top 5 years by total number of earthquakes in the period from 1900 to 2013

Year	Occurrence	No. of people killed	No. of people injured	No. of people affected	Homeless	Total affected	Estimated damage (\$)
1901	86	36	0	0	0	0	0
1902	84	13494	0	0	0	0	0
1903	80	12000	0	0	0	0	0
1904	72	0	0	0	0	0	0
1905	66	45082	0	0	0	0	0

Source of data: EM-DAT: The OFDA/CRED International Disaster Database

Most earthquakes occurred in 1901 and amounted to 86, then in 1902, 1903, 1904 and 1905 (Table 6). By the number of the killed, the year 1976 is remembered - 553.988, and based on the number of the injured, the year 2008 is remembered - 741.878 (EM-DAT, 2013).

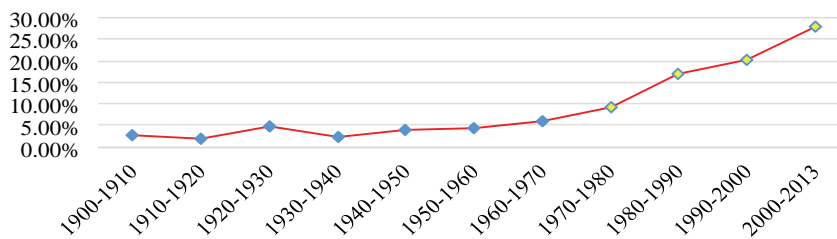


Figure 5. Percentage overview of the total number of earthquakes in the period from 1900 to 2013. Source of data: EM-DAT: The OFDA/CRED International Disaster Database

In the period from 2000 to 2013 most earthquakes happened, and they amount to 27.94% in relation to the total observed period. Also, in the period from 1900 to 1970, the number of earthquakes was average, while in subsequent years the number was increasing from the average, so that in the period from 2000 to 2013 it reached 27.94% (Figure 5).

Volcanic eruptions

A volcano is a mountain that opens downwards to a reservoir of molten rock below the surface of the earth. Unlike most mountains, which are pushed up from below, volcanoes are built up by an accumulation of their own eruptive products, i.e. lava, ash flows, and airborne ash and dust (Perry & Godchaux, 2005:186). When pressure from gases and the molten rock becomes strong enough to cause an explosion, an eruption occurs. A volcanic eruption is the manner in which gases, liquids, and solids are expelled from the earth’s interior onto its surface (Marlene & Carmichael, 2007:268).

Table 7. Review of total number and consequences of volcanic eruptions in the period from 1900 to 2013, with regard to the average annual, monthly and daily distribution

Period 1900-2013	Occurrence	No. of people killed	No. of people injured	No. of people affected	Homeless	Total affected	Estimated damage (\$)
Total	452	192624	23238	9789114	751580	10563962	6080696
Annually	4	1704	205	86629	6651	93486	53811
Monthly	0,33	142	17	7219	554	7790	4484
Daily	0,011	12	0,57	241	18	260	149

Source of data: EM-DAT: The OFDA/CRED International Disaster Database

During the period from 1900 to 2013, there were 452 volcanic eruptions. Their consequences are 192.624 killed, 23.238 injured, 9.789.114 affected and 751.580 homeless people. Thus, the total number of affected people was 10.563.962. Total estimated damage amounted to 6.080.696 U.S. dollars. On average, there were annually 4, monthly 0.03, daily 0.011 volcanic eruptions (Table 7).

In terms of percentage, as a consequence of volcanic eruptions, the most people were killed in the period from 1900 to 1910 (46,07%), while the least were killed in the period from 2000 to 2013. The most people were injured in the period from 1980 to 1990 (51,40%), whereas the least from 1900 to 1910 and from 1920 to 1960 (0%). The most people were affected in the period from 1990 to 2000 (41,50%), whereas the least in the period from 1900 to 1930 (0%). The most people were made homeless in the period from 2000 to 2013 (30,87%), while the least in the period from 1900 to 1940 (0%) (Figure 6).

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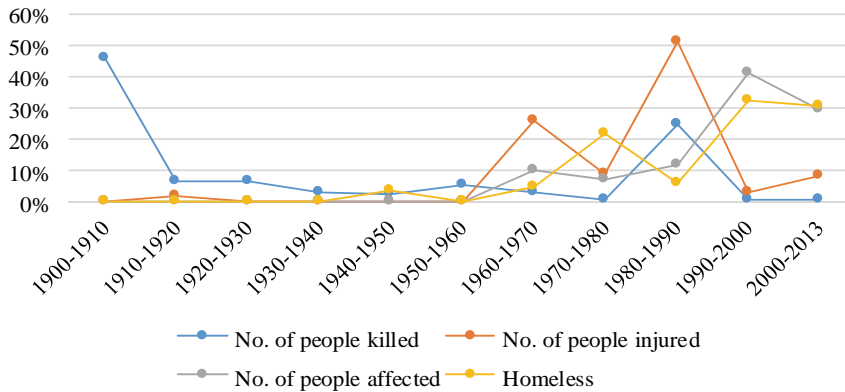


Figure 6. Percentage overview of effects of volcanic eruptions in the period from 1900 to 2013. Source of data: EM-DAT: The OFDA/CRED International Disaster Database

Table 8. Review of total number of volcanic eruptions in period from 1900 to 2013, classified by continents

Continent	Occurrence	No. of people killed	No. of people injured	No. of people affected	Homeless	Total affected	Estimated damage (\$)
Asia	186	43576	9764	5804290	207800	6021854	1416702
Americas	162	135716	11678	2873116	62360	2947154	4337394
Oceania	46	7330	62	427738	92000	519800	220000
Africa	34	4436	1686	659600	361420	1022706	18000
Europe	24	1566	48	24400	28000	52448	88600
Total	452	192624	23238	9789144	751580	10563962	6080696

Source of data: EM-DAT: The OFDA/CRED International Disaster Database

The most volcanic eruptions occurred in Asia 186, and least in Europe 24. So by the number of volcanic eruptions, the first is Asia, then the Americas, Oceania, Africa and, finally, Europe (Table 8).

Table 9. Top 5 countries by volcanic eruptions in the period from 1900 to 2013

Country	Occurrence	No. of people killed	No. of people injured	No. of people affected	Homeless	Total affected	Estimated damage (\$)
Indonesia	104	36542	7318	2297734	47000	2352052	688780
Philippines	50	5992	2376	3308838	158600	3469814	463922
Japan	30	1030	40	197718	2200	199958	264000
Papua N.	28	7030	62	372798	92000	464860	220000
Kolumbija	26	45652	10026	103902	0	113928	2000000

Source of data: EM-DAT: The OFDA/CRED International Disaster Database

The most volcanic eruptions occurred in Indonesia - 104, Philippines - 50, Japan - 30 and Papua N. G.- 28 (Table 9). Also, it is important to mention that in the past 113 years, the most people were killed in Martinique - 60.000, while the most people were injured in Colombia - 10.026 (EM-DAT, 2013).

Table 10. Top 5 years by number of volcanic eruptions in the period from 1900 to 2013

Year	Occurrence	No. of people killed	No. of people injured	No. of people affected	Homeless	Total affected	Estimated damage (\$)
2006	24	10	26	757196	0	757222	300000
1991	20	1366	430	2369098	16800	2386328	474000
2005	16	6	0	682000	0	682000	0
1983	14	0	0	97870	2200	100070	350380
1984	14	74	0	202000	0	202000	0

Source of data: EM-DAT: The OFDA/CRED International Disaster Database

The most volcanic eruptions (24) occurred in 2006., then in 1991-20, 16 in 2005, 14 in 1983 and 14 in 1984 (Table 10). By the number of the killed, the year 1902 is remembered - 77.380 people. By the number of the injured, the year 1985 is remembered - 43.600 people (EM-DAT, 2013).

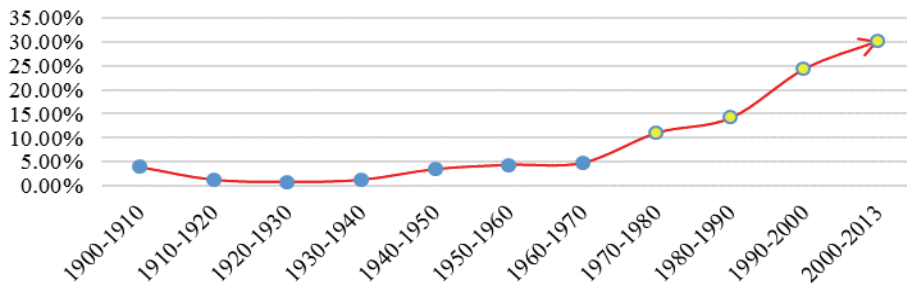


Figure 7. Percentage overview of the total number of volcanic eruptions in the period from 1900 to 2013. Source of data: EM-DAT: The OFDA/CRED International Disaster Database

Trends of volcanic eruptions are such that, for example, from 1900 to 1970, the number of volcanic eruptions was on average to 10% in relation to the total observed period. After 1970, the number of volcanic eruptions was increasing, and in the period from 2000 to 2013 it reached its maximum of 30.09% (Figure 7).

Mass movement dry

Mass movement (mass wasting) encompasses several different types of slope failure events influenced by natural forces. These events can occur rapidly or require an extended time to occur. There are also different moisture

requirements for onset (Stoltman, Lidstone, & Dechano, 2007). Landslide is a general term referring to any perceptible mass movement of earth materials down the slope in response to gravity (Marlene & Carmichael, 2007:189).

Table 11. Review of total number and consequences of mass movement dry in the period from 1900 to 2013, with regard to the annual, monthly and daily distribution

Mass movement dry	Occurrence	No. of people killed	No. of people injured	No. of people affected	Homeless	Total affected	Estimated damage (\$)
Total	110	10034	1022	45376	11962	58360	503200
Annually	0.97	89	9	402	106	4489	4453
Monthly	0.08	7	0.75	33	9	374	371
Daily	0.002	0.24	0.025	1.11	0.3	12	12

Source of data: EM-DAT: The OFDA/CRED International Disaster Database

During the period from 1900 to 2013, there were 110 mass movement dry. Their consequences are 10.034 killed, 1.022 injured, 45.376 affected and 11.962 homeless people. Thus, the total number of affected people was 58.360. Total estimated damage amounted to 503.200 U.S. dollars. On average, there were 0.97 mass movement dry annually, 0.08 monthly and 0.002 daily (Table 11).

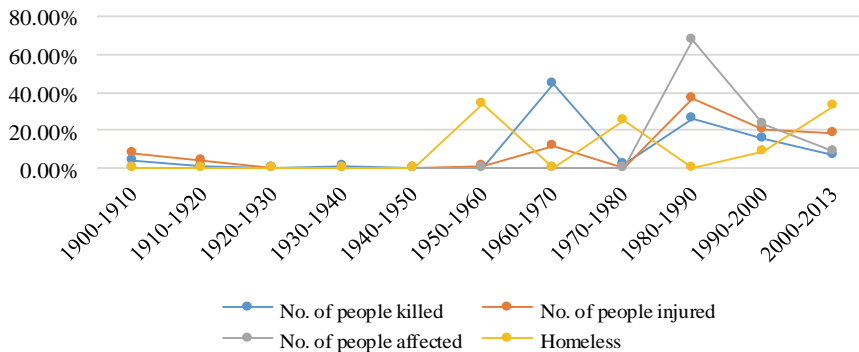


Figure 8. Percentage review of the effects of massive movement dry on in the period from 1900 to 2013. Source of data: EM-DAT: The OFDA/CRED International Disaster Database

In terms of percentage, as a consequence of mass movements dry, the most people were killed in the period from 1960 to 1970 (44,21%), while the least were killed in the period from 1920 to 1930, and from 1940 to 1950 (0%). The most people were injured in the period from 1980 to 1990 (36,40%), whereas the least from 1920 to 1950 and from 1970 to 1980 (0%). The most people were affected in the period from 1980 to 1990 (67,66%), whereas the least in the period from 1900 to 1980 (0%). The most people were made homeless in the

period from 1950 to 1960 (33,40%), while the least in the period from 1900 to 1950, from 1960 to 1970 and from 1980 to 1990 (0%) (Figure 8).

Table 12. Review of the total number and consequences of mass movement dry in the period from 1900 to 2013, classified by continents

Continent	Occurrence	No. of people killed	No. of people injured	No. of people affected	Homeless	Total affected	Estimated damage (\$)
Asia	42	3438	508	13302	1480	15290	98000
Americas	36	5442	254	8574	9232	18060	400000
Europe	18	538	116	20500	0	20616	5200
Africa	10	444	144	1000	1250	2394	0
Oceania	4	172	0	2000	0	2000	0
Total	110	10034	1022	45376	11962	58360	503200

Source of data: EM-DAT: The OFDA/CRED International Disaster Database

Most mass movement dry happened in Asia - 42 and least in Oceania - 4. So, by mass movement dry, the first is Asia, then Americas, Europe, Africa and Oceania at the end (Table 12).

Table 13. Top 5 countries by number of mass movement dry in the period from 1900 to 2013

Country	Occurrence	No. of people killed	No. of people injured	No. of people affected	Homeless	Total affected	Estimated damage (\$)
Canada	16	610	182	0	7000	7182	0
China	14	1000	270	10000	680	10950	96000
USA	8	290	12	17000	0	17012	0
Colombia	6	494	72	4500	250	4822	0
France	6	128	104	0	0	104	0

Source of data: EM-DAT: The OFDA/CRED International Disaster Database

Most mass movement dry happened in Canada- 104, China 14, USA 8, Columbia 6 and in France 6 (Table 13). Also, in the past 113 years, due to mass movement dry the most people were killed in Peru - 4.000 and the most people were injured in China - 1.000 (EM-DAT, 2013).

Table 14. Top 5 years by number of mass movement dry in the period from 1900 to 2013

Year	Occurrence	No. of people killed	No. of people injured	No. of people affected	Homeless	Total affected	Estimated damage (\$)
1992	10	646	138	5500	800	6438	5200
1993	10	682	72	5100	250	5422	0
1983	8	932	30	0	0	30	0
1988	6	314	0	2000	0	2000	0
1989	6	110	0	16000	0	16000	0

Source of data: EM-DAT: The OFDA/CRED International Disaster Database

The most mass movements dry happened in 1992 and amounted to 10, then in 1993, 1983, 1988 and in 1989 (Table 14). By the number of the killed, the year

1962 is remembered - 4.000, while by the number of the injured, 1990 is remembered - 230 people (EM-DAT, 2013).

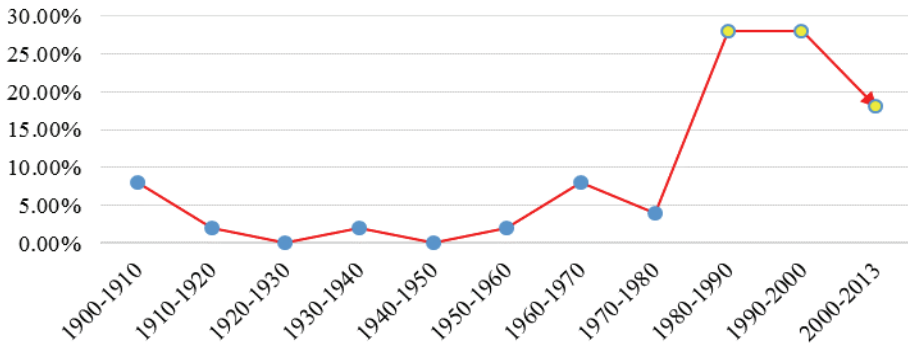


Figure 9. Percentage overview of the total number of massive movement dry in the period from 1900 to 2013. Source of data: EM-DAT: The OFDA/CRED International Disaster Database

From 1900 to 1970, the number of volcanic eruptions was on average up to 10% in relation to the number of eruption of the total observed period. From 1970 to 2000, the number of volcanic eruptions increases, whereas after 2000 it slowly decreases (Figure 9).

Conclusion

Analyzing phenomenology, ie. forms of manifestations, consequences, temporal and spatial distribution of geophysical disasters (earthquakes, volcanic eruptions and mass movement dry) around the world, in the period from 1900 to 2013, we have come to the following conclusions:

In relation to the total number of natural disasters in the period, which amounted to 25.552, geophysical disasters are in the third place according to its frequency - 11.89%. In the first place are hydrological disasters - 37.40%, and the last are biological ones - 11.04%.

In relation to the total number of people killed in natural disasters, which is 65.009.766, geophysical disasters are in the fourth place - 20.8%. In the first are climatological- 36.57%, biological - 29.46%, hydrological- 21.52% and in the last place are meteorological ones - 4.26%.

In relation to the total number of people injured in natural disasters which is 15.221.227, geophysical disasters are in the first place - 34.01%. The second are climatological- 24.83% then hydrological- 17.44%, meteorological- 17.35% and biological ones - 17.44%.

In relation to the total number of people who were made homeless in natural disasters, which is 337.112.287, geophysical disasters are in third place-13.62%. In the first place are hydrological disasters - 54.94%, meteorological - 31.16%, climatological - 0.27% and, in the end, biological ones 0%.

In the period, there occurred 3.037 geophysical disasters, 2.475 of which were earthquakes, 452 volcanic eruptions and 110 mass movements dry. In percentage terms, earthquakes have occurred in 81.49% of cases, volcanic eruptions in 14.88%, and mass movement dry in 3.62%.

In geophysical disasters 5.331.007 people have been killed, 5.128.349 of which in earthquakes, 192.624 in volcanic eruptions and 10.034 in the mass movement dry.

In geophysical disasters 5.177.147 people have been injured, 5.152.887 of which in earthquakes, 23.238 in volcanic eruptions and 1.022 in mass movements dry;

In the period, characteristics of earthquakes were as follows: in Asia it was the largest number: China has experienced the largest number of earthquakes with the largest number of people killed and injured; most earthquakes happened in 1901; in 1976 the earthquakes caused the greatest number of people killed; in 2008 the earthquakes injured most people.

In terms of the number and characteristics of consequences of volcanic eruptions, the following is concluded: most volcanic eruptions were in Asia-Indonesia has experienced the largest number of volcanic eruptions; Martinique had the largest number of people killed, and Colombia the largest number of people injured; most volcanic eruptions occurred in 2006; the most people were killed in 1902; the most people injured in 1985.

In terms of the number and characteristics of consequences of mass movement dry, it is clear that they were mostly in Asia; by countries- Canada has experienced the largest number of mass movement dry, in Peru the most people were killed, while there was the largest number of people injured in China.

On an annual basis, the total number of earthquakes, volcanic eruptions and mass movements dry until 1970 was average, with some degree of deviation from the annual average of the total observed period, but after that, a serious increase in their number and effects has been observed.

References

- Cvetković, V. (2013). *Intervetno-spasilačke službe u vanrednim situacijama*. Beograd: Zadužbina Andrejević.
- Davis, L. (2008). *Natural Disasters*. New York: Facts On File.
- Edward, B. (2005). *Natural Hazards, Second Edition*. Cambridge: University Press.
- EM-DAT: The OFDA/CRED International Disaster Database, available www.cred.be/emdat/welcome.htm (accessed July 2013).
- Eshghi, K. & Larson, R. (2008). Disasters: lessons from the past 105 years. *Disaster Prevention and Management*, 17(1), 62 – 82.
- Guha, D., Vos, F., Below, R., & Ponserre, S. (2012). *Annual Disaster Statistical Review 2011: The Numbers and Trends*. Brussels: CRED.
- Haddow, G., Bullock, J., & Coppola, D. (2011). *Introduction to Emergency Management: Fourth Edition*. USA: Elsevier, Inc.
- Marlene, B., & Carmichael, R. (2007). *Notable Natural Disasters*. California: Salem Press, Inc.
- Mijalković, S. (2009). *Bezbednost države i koncepti međunarodne bezbednosti*, *Defendologija*, No 25–26. Banja Luka: Defendologija centar, 69–83.
- Mijalković, S. (2011). *Nacionalna bezbednost*. Beograd: Kriminalističko-policijska akademija.
- Mladan, D., Cvetković, V. (2013). Classification of emergency situations. In Press, Belgrade: The Academy of Criminalistic and Police studies, International Scientific Conference.
- Perry, W. R. & Godchaux, J. (2005). Volcano hazard management strategies: Fitting policy to patterned human responses. *Disaster Prevention and Management*, 14(2) 183 – 195.
- Shaluf, I. M. (2007). An overview on disasters. *Disaster Prevention and Management*, 16(5) pp. 687 – 703.
- Shaluf, I. M., Ahmadun, F. & Said, A.M. (2003). A review of disaster and crisis. *Disaster Prevention and Management*, 12 (1), 24-32.
- Stoltman, J., Lidstone, J., & Dechano, L. (2007). *International perspectives on natural disasters: occurrence, mitigation, consequences*. The Netherland: Springer.

