

# **EARTHQUAKE THREAT TO MUNICIPALITIES AND SETTLEMENTS IN SLOVENIA**

## **POTRESNA OGROŽENOST OBČIN IN NASELIJ V SLOVENIJI**

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After earthquake in 1976 at Breginj  
(NW Slovenia, photography M. Orožen Adamič)  
Po potresu leta 1976 v Breginju  
(SZ Slovenija, fotografija M. Orožen Adamič)



Abstract

UDC: 550.34(497.4)

## **Earthquake Threat to Municipalities and Settlements in Slovenia**

Since January 1, 1995, Slovenia has had 147 municipalities and almost 6,000 settlements. Using the Geographical Information System, we combined a layer with seismic zones, a layer with municipal borders, and a layer with centroids (coordinates) of settlements. For every municipality and settlement in Slovenia we first determined a partial assessment of the earthquake threat to municipalities relative to surfaces and population, a partial assessment of the earthquake threat to settlements relative to population, relative to the threat to the active population, that is, to the number of work places, and relative to the age of housing. We then obtained an aggregate assessment of the earthquake threat to settlements relative to population and the age of housing.

Izvleček

UDK: 550.34(497.4)

## **Potresna ogroženost občin in naselij v Sloveniji**

V Sloveniji imamo od 1. 1. 1995 147 občin in skoraj 6000 naselij. S pomočjo geografskega informacijskega sistema smo povezali sloj s seizmičnimi območji, sloj z mejami občin in sloj s centri (koordinatami) naselij ter za vsako občino in naselje v Sloveniji najprej določili delno oceno potresne ogroženosti občin glede na površine in število prebivalcev, delno oceno potresne ogroženosti naselij glede na število prebivalcev, glede na ogroženost aktivnega prebivalstva oziroma število delovnih mest in glede na starost stanovanj, nato pa še skupno oceno potresne ogroženosti naselij glede na število prebivalcev in starost stanovanj.

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# 1. Introduction

Slovenia is a country of great regional diversity because it is located at the junction of four major European geographical units: the Alps, the Dinaric Alps, the Pannonian Basin, and the Mediterranean. We therefore find a great diversity of natural phenomena and consequently numerous natural disasters.

Natural disasters are a common geographical phenomena and are a result of intertwined natural and human activities. It is common to natural disasters that they are exceptional phenomena that cause damage. If there is no damage, we can only speak of more or less interesting natural phenomena. A variety of institutions in Slovenia are involved in the study of natural disasters. The Geographical Institute of the Scientific Research Center of the Slovene Academy of Science and Art has the longest and richest tradition, and for several years the Department for Natural Disasters has operated under its auspices.

The damage caused annually in Slovenia by natural disasters varies from year to year. Due to the consequences of an earthquake in the Soča region (Geipel 1982) and other natural disasters, damage in 1976 rose to more than six percent of Slovenia's GDP for that year (Ahčan 1988). In individual parts of Slovenia this figure is often exceeded several times over. It is characteristic of Slovenia that the number of victims of natural disasters is small while the material damage is great, and with the growth of its economic power this type of damage is further increasing. With a per capita income of 10,000 USD, Slovenia ranks today among the richest countries (43rd in the world in 1995).

In recent decades, there have been no natural disasters of world proportions in Slovenia; the greatest number of victims have been claimed by avalanches. Over the long term, however, the most lives were taken and the greatest damage caused on Slovene ethnic territory and its margins by earthquakes: in 1348 there were about 500 victims in the Villach earthquake; in 1511, an earthquake destroyed many castles; the Ljubljana earthquake of 1895 damaged Ljubljana considerably (Lapajne, Tomaževič, 1991); and as a result of the 1976 Friuli earthquake, more than a thousand people lost their lives. Slovenia lies in an area of tectonically active alpidic territory where in the most threatened regions we can expect earthquakes of up to 9° on the MCS scale, and locally even stronger ones (Orožen Adamič, Sheppard, Tomaževič 1988; Orožen Adamič, 1995).

An important part of preventing earthquake damage is the assessment of earthquake threat carried out in the framework of the *Earthquake Threat and Safety from Earthquakes* research project financed by Slovenia's Ministry of Science and Technology and Ministry of Defense. This article is a summary of some of the work of this project.

To determine an estimate of the earthquake threat to settlements and population, a Geographical Information System with four basic layers has been established for the whole of Slovenia. The foundation layer of the Geographical Information System is a 100 × 100 meter digital relief model (Republiška ... 1989) which makes possible the locating of all natural phenomena and processes in the environment relative to latitude and longitude, that is, the Gauss-Krüger coordinate system that has been standard in Slovenia for some time (Banovec 1975; Perko 1991), and height above sea level. As to content, the most significant layer is the second, containing data from the seismological map for five hundred year return periods elaborated through the digitalization of seismic zones from the 1987 1 : 1,000,000 scale Seismological Map of the Federal Republic of Yugoslavia (Office of Seismology of Yugoslavia, Ribarič 1987). This map is also the basis for currently applied building regulations and construction technology practices (Pravilnik..., 1964, 1981, 1982). The National Geophysics Administration of the Republic of Slovenia is preparing a new map, but as it is not completely finished it is not yet a component part of the corresponding legislation.

The third layer was created using the register of municipal territorial units of the Geodetic Office of the Republic of Slovenia (1995) which also contains the digitalized borders of the new Slovene municipalities that were the basis for calculations related to the municipalities. This vectored layer was also rastered at the density of dots of the 100 × 100 meter digital relief model in the same manner as with the seismic zones to one hectare precision

Using the coordinates of settlements shown on the final (Republiška ... 1991), fourth basic layer of our Geographical Information System, we combined the first three layers with the extensive data base from the last census of population and housing according to settlements (Popisi ... 1961, 1991).

By overlapping the individual layers and using various techniques (Rase 1988) offered by the Geographical Information System, we first analyzed the position of each settlement in Slovenia relative to seismic zones and then determined an assessment of the earthquake threat for settlements and municipalities relative to various elements. We also provided an aggregate assessment of the threat to settlements relative to two most important indicators: the location of a settlement in a specific seismic zone and the age of the housing in the settlement.

Finally, we created synthesized layers of our Geographical Information System in which we considered many indicators simultaneously and linked the Geographical Information System directly to thematic cartography in order to illustrate this article with thematic maps on which all the settlements are shown. The surface area of a settlement (the size of its square) indicates its population during the 1991 census, while the colour of the settlement (square) indicates a 12 degree assessment of the earthquake threat for each settlement relative to the position of the settlement in a seismic zone and to the predominant age of the housing. For better orientation, we added the borders of individual seismic zones as well as the borders of the municipalities.

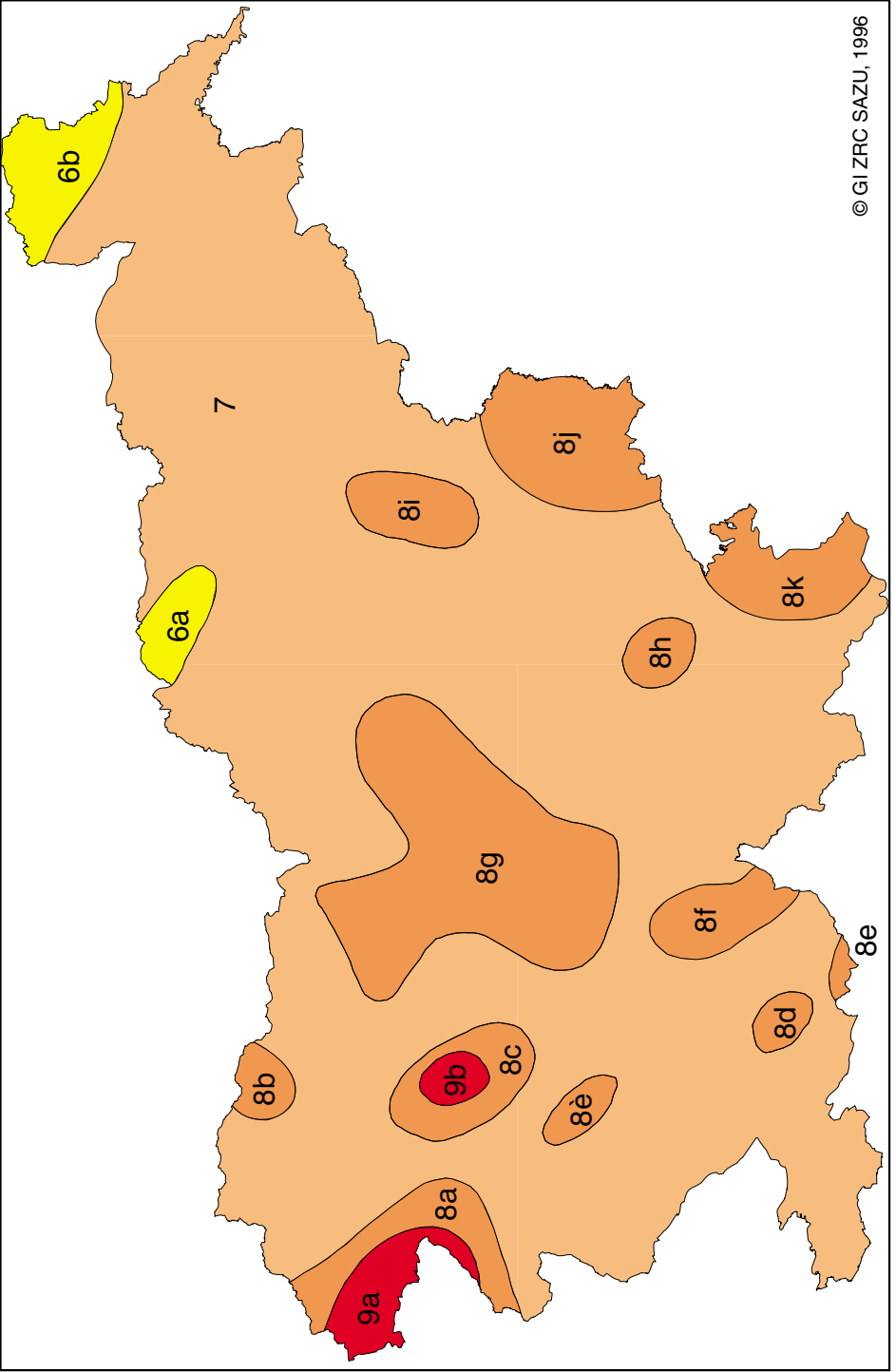
## 2. Seismic Zones

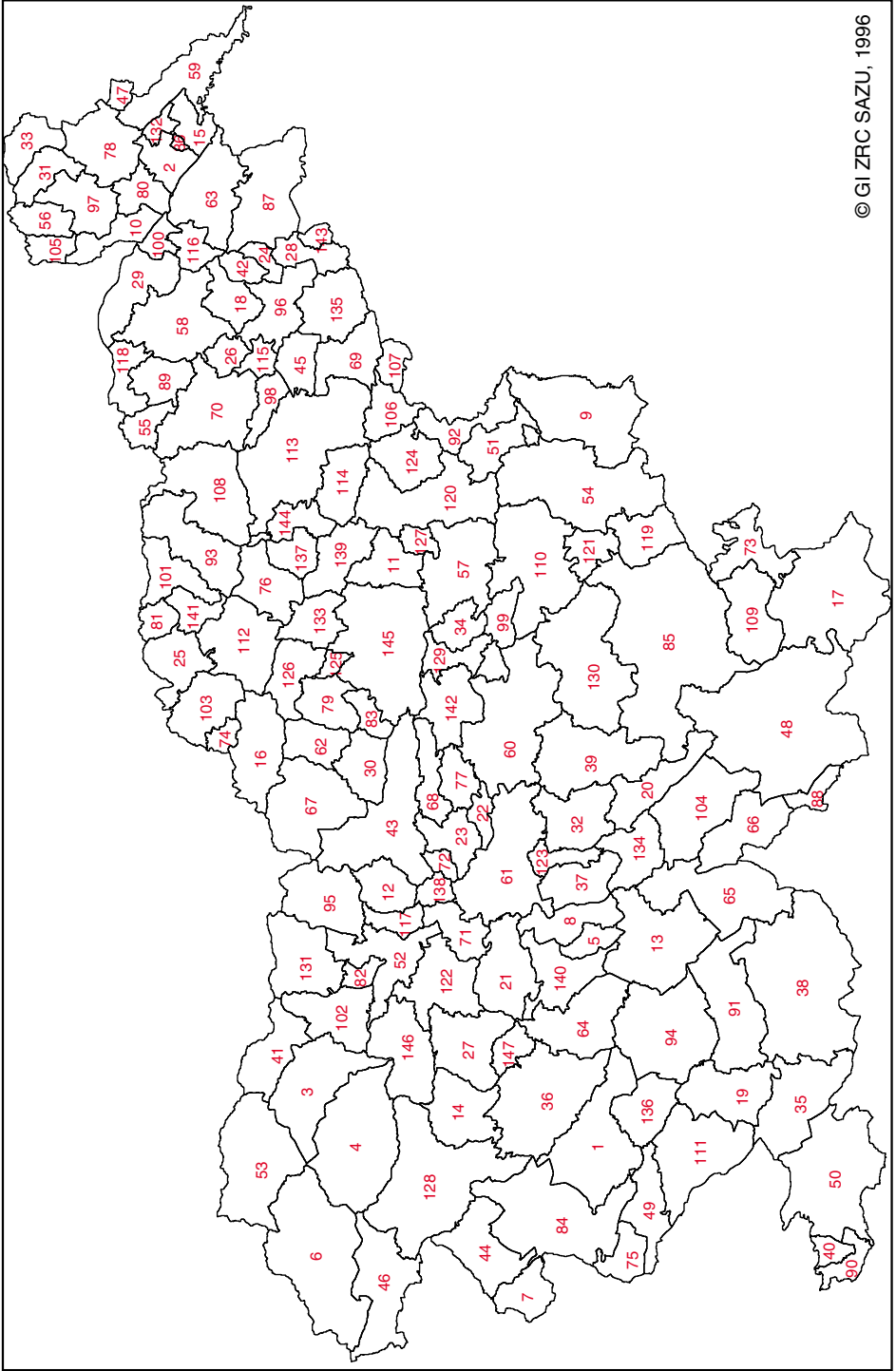
According to the 1987 seismic map for five hundred year return periods, Slovenia has seventeen seismic zones ranging from 6° to 9° on the MCS scale. Two zones are in the highest 9° MCS range, twelve zones are in the 8° range, there is only one zone in the 7° range, and two zones are in the 6° range (Orožen Adamič 1984, 1985).

Zone 9a covers the well known earthquake region of the Upper Soča Valley that was severely affected during the 1976 earthquakes. We can call it simply the "Upper Soča Earthquake Zone." This zone stretches from Slovenia across the border with Italy into Friuli-Venezia Giulia, Resia, and the margin of the Po lowlands where the earthquake epicenters were located in 1976. In Slovenia this region covers the Soča Valley from Trnovo through Kobarid and Tolmin to Most na Soči. Here also belongs the watershed of the Nadiža River with Breginjski kot, the area most affected in Slovenia in 1976. This is the area of the former Municipality of Tolmin, the largest in Slovenia at the time, which today is divided into four municipalities: Kobarid, Bovec, Tolmin, and Kanal. In total, this largest zone of 9° MCS extends over 27,126 ha. or 1.3% of the surface of Slovenia. During the 1991 census only 6,399 people or 0.3% of Slovenia's population lived here.

Figure 1: Seismological map of Slovenia for the 500 year return period with seismic zones whose numbering denotes the highest expected MCS degree (M 1 : 1,300,000; Ribarič 1987).

Slika 1: Seizmološka karta Slovenije za povratno periodo 500 let s seizmičnimi območji, v katerih številka označuje največjo pričakovano MCS stopnjo (M 1 : 1,300,000; Ribarič 1987).





KEY TO FIGURE 2: MUNICIPALITIES OF THE REPUBLIC OF SLOVENIA AS OF JANUARY 1, 1995.  
 LEGENDA K SLIKI 2: OBČINE REPUBLIKE SLOVENIJE PO STANJU 1. 1. 1995.

Number on Map	Name of Municipality	Number on Map	Name of Municipality	Number on Map	Name of Municipality
1	Ajdovščina	49	Komen	99	Radeče
2	Beltinci	50	Koper/Capodistria	100	Radenci
3	Bled	51	Kozje	101	Radlje ob Dravi
4	Bohinj	52	Kranj	102	Radovljica
5	Borovnica	53	Kranjska Gora	103	Ravne-Prevalje
6	Bovec	54	Krško	104	Ribnica
7	Brda	55	Kungota	105	Rogaševci
8	Brezovica	56	Kuzma	106	Rogaška Slatina
9	Brežice	57	Laško	107	Rogatec
10	Cankova-Tišina	58	Lenart	108	Ruše
11	Celje	59	Lendava/Lendva	109	Semič
12	Cerklje na Gorenjskem	60	Litija	110	Sevnica
13	Cerknica	61	Ljubljana	111	Sežana
14	Čerkno	62	Ljubno	112	Slovenj Gradec
15	Črenšovci	63	Ljutomer	113	Slovenska Bistrica
16	Črna na Koroškem	64	Logatec	114	Slovenske Konjice
17	Črnomelj	65	Loška dolina	115	Starše
18	Destrnik-Trnovska vas	66	Loški Potok	116	Sveti Jurij
19	Divača	67	Luče	117	Šenčur
20	Dobropolje	68	Lukovica	118	Šentilj
21	Dobrova-Horjul-Polhov Gradec	69	Majšperk	119	Šentjernej
22	Dol pri Ljubljani	70	Maribor	120	Šentjur pri Celju
23	Domžale	71	Medvode	121	Škocjan
24	Dornava	72	Mengeš	122	Škofja Loka
25	Dravograd	73	Metlika	123	Škofljica
26	Duplek	74	Mežica	124	Šmarje pri Jelšah
27	Gorenja vas-Poljane	75	Miren-Kostanjevica	125	Šmartno ob Paki
28	Gorišnica	76	Mislinja	126	Šoštanj
29	Gornja Radgona	77	Moravče	127	Štore
30	Gornji Grad	78	Moravske Toplice	128	Tolmin
31	Gornji Petrovci	79	Mozirje	129	Trbovlje
32	Grosuplje	80	Murska Sobota	130	Trebnje
33	Hodoš-Šalovci/ Hodos-Šalovci	81	Muta	131	Trzin
34	Hrastnik	82	Naklo	132	Turnišče
35	Hrpelje-Kozina	83	Nazarje	133	Velenje
36	Idrija	84	Nova Gorica	134	Velike Lašče
37	Ig	85	Novo mesto	135	Videm
38	Ilirska Bistrica	86	Odranci	136	Vipava
39	Ivančna Gorica	87	Ormož	137	Vitanje
40	Izola/Isoła	88	Osilnica	138	Vodice
41	Jesenice	89	Pesnica	139	Vojnik
42	Juršinci	90	Piran/Pirano	140	Vrhnika
43	Kamnik	91	Pivka	141	Vuzenica
44	Kanal	92	Podčetrtek	142	Zagorje ob Savi
45	Kidričevo	93	Podvelka-Ribnica	143	Zavrč
46	Kobarid	94	Postojna	144	Zreče
47	Kobilje	95	Preddvor	145	Žalec
48	Kočevje	96	Ptuj	146	Železniki
		97	Puconci	147	Žiri
		98	Rače-Fram		

Figure 2: Municipalities of the Republic of Slovenia as of January 1, 1995 (M 1 : 1,300,000; Republiška ... 1995).  
 Slika 2: Občine Republike Slovenije po stanju 1. 1. 1995 (M 1 : 1,300,000; Republiška ... 1995).



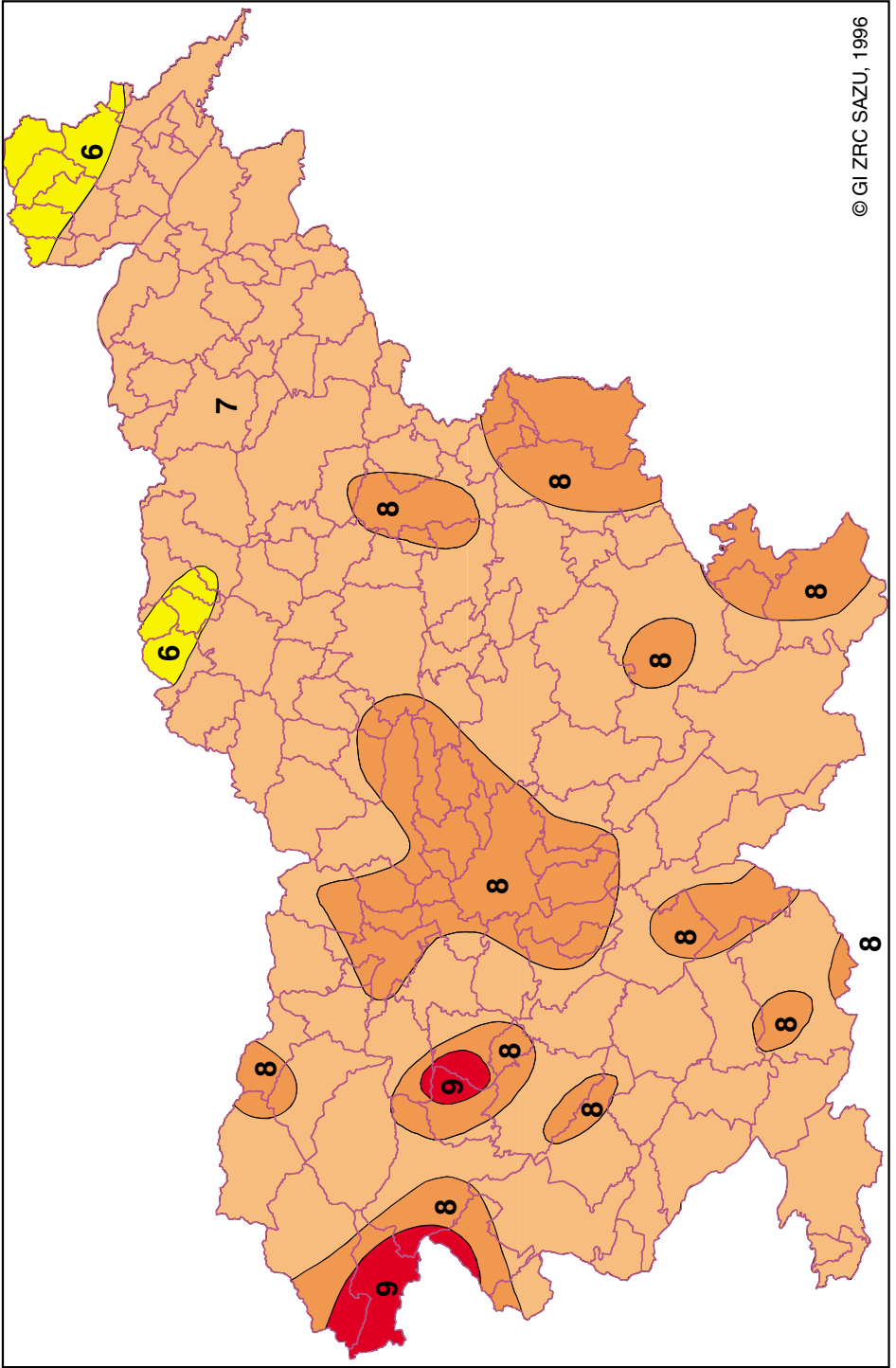


TABLE 1: SURFACES AND POPULATION ACCORDING TO SEISMIC ZONES.  
PREGLEDNICA 1: POVRŠINE IN PREBIVALSTVO PO SEIZMIČNIH OBMOČJIH.

Zone	Surface in ha.	Proportion of surface in %	Population 1961	Population 1991	Proportion of population 1991	Index of population 1961/91	Density of population (no. of people per km <sup>2</sup> 1991)	Number of active population 1991
6 a	18299	0.90	11893	13108	0.67	110	72	4616
6 b	37020	1.83	24216	17514	0.89	72	47	7235
Total 6	55391	2.73	36109	30622	1.56	85	55	11851
Total 7	1502247	74.11	1083335	1284614	65.34	119	86	556080
8 a	35029	1.73	16624	17286	0.88	104	49	8007
8 b	11593	0.57	18106	21867	1.11	121	189	10061
8 c	29037	1.43	12764	13785	0.70	108	47	5232
8 c	9839	0.48	1753	1441	0.07	82	15	393
8 d	8647	0.43	7559	7922	0.40	105	92	3495
8 e	3300	0.16	1071	806	0.04	75	24	173
8&f	26682	1.32	5438	5254	0.27	97	20	2154
8 g	169222	8.34	296935	463459	23.58	156	274	217809
8 h	13077	0.65	7028	7941	0.40	113	61	2975
8 i	25913	1.28	19259	21523	1.09	112	83	6378
8 j	61587	3.04	52200	53677	2.73	103	87	24591
8 k	39303	1.94	21695	25216	1.28	116	64	10714
Total 8	433229	21.37	460432	640213	32.56	139	148	291982
9 a	27126	1.34	7851	6399	0.33	82	24	1968
9 b	9206	0.45	3996	4174	0.21	104	45	2589
Total 9	36332	1.79	11847	10573	0.54	89	29	4557
Slovenia	2027199	100.00	1591723	1965986	100.00	124	97	864470

Zone 9 b is the second 9° MCS zone and is traditionally called the “Idrija Earthquake Zone.” This was the former Municipality of Idrija that is now covered by the municipalities of Cerkno, Gorenja vas-Poljane, and partly by Železniki. Its surface area is 9,206 hectares or 0.5% of the surface of Slovenia; according to the 1991 census, only 4,174 people or 0.2% of the population of Slovenia live here.

Altogether there are seven municipalities that have surface areas in the 9° MCS zones, a fact clearly evident in Table 5. During the 1976 earthquake there were effects between 8° and 9° MCS here. The two 9° MCS zones together measure 36,332 hectares or 1.8% of the surface of Slovenia and in 1991 had a population of 10,573 or 0.5% of the population of Slovenia.

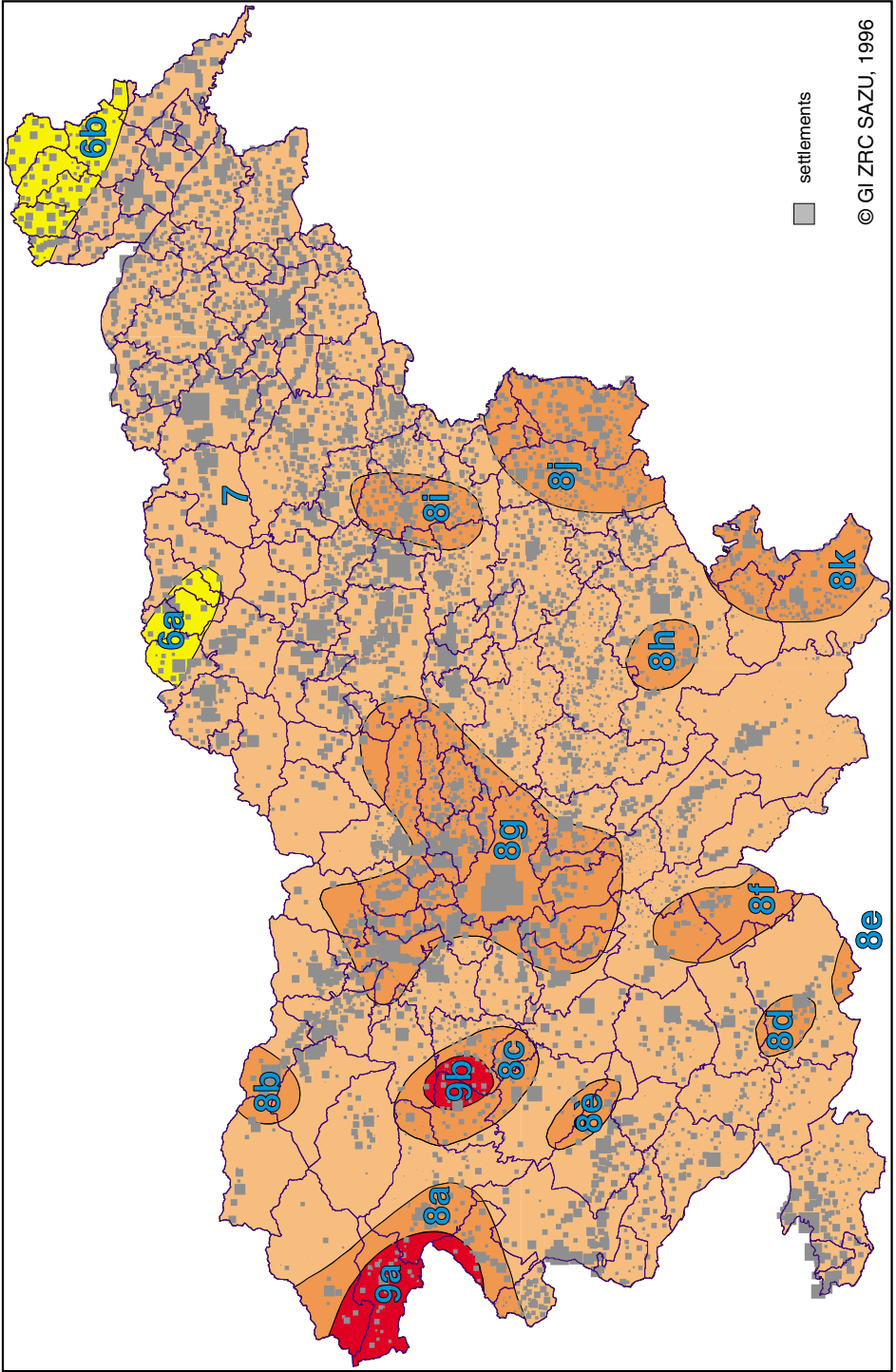
There are twelve 8° MCS earthquake zones in Slovenia. Altogether they cover 433,292 ha. or 21.4% of the surface, and 640,213 people or 32.6%, about a third, of the population of Slovenia live in them. Earthquake zone 8 a surrounds the 9° MCS Upper Soča Earthquake Zone. It covers the municipalities of Bovec, Kobarid, Kanal, and Brda and touches the Municipality of Nova Gorica. In total it covers 35,029 ha. or 1.7% of the surface of Slovenia and has 17,286 people or 0.9% of the population of Slovenia.

Earthquake zone 8 b could be called the “Jesenice Earthquake Zone” because it covers part of the Municipality of Jesenice, the less settled northern part of the Municipality of Bled, and the extreme eastern part of the Municipality of Kranjska Gora. Its surface is 11,593 ha. or 0.6% of Slovenia. Its northern part leans against the Karavanke Mountains and reaches across the border into Austria. In 1991, 21,867 people or 1.1% of the population of Slovenia lived here.

Earthquake zone 8 c is similar to zone 8 a, as it surrounds the 9° MCS Idrija Earthquake Zone (9 b). It is almost one third smaller, however, covering an area of 29,037 ha. or 1.4% of the area of Slovenia.

Figure 3: Seismological map of Slovenia for the 500 year return period with seismic zones whose numbering denotes the highest expected MCS degree, with municipality borders (M 1 : 1,300,000).

Slika 3: Seizmološka karta Slovenije za povratno periodo 500 let s seizmičnimi območji, v katerih številka označuje največjo pričakovano MCS stopnjo, in z občinskimi mejami (M 1 : 1,300,000).



It reaches to the municipalities of Tolmin, Železniki, Gorenja vas-Poljane, Žiri, Idrija, and Cerklje. In 1991, 13,785 people or 0.7% of the population lived here.

There is no doubt that zones 9 a, 9 b, 8 a, and 8 c jointly comprise the most earthquake threatened parts of the territory of Slovenia.

Earthquake zone 8 č is in Trnovski gozd on the highest karst plateau along the border of the municipalities of Idrija and Ajdovščina. Relative to its surface area and number of residents, it belongs among the smaller earthquake zones since it measures 9,839 ha. or 0.5% of the surface of Slovenia and has 1,441 people or barely 0.1% of the population of Slovenia.

Earthquake zone 8 d is known as the “Ilirska Bistrica Earthquake Zone” and has had numerous earthquakes that so far have not been extremely destructive. The greater part of this earthquake zone lies in the Municipality of Ilirska Bistrica, and to the north it also reaches into the Municipality of Pivka. It covers 8,647 ha. or 0.4% of the surface of Slovenia and has 7,922 people or 0.4% of the population of Slovenia.

Earthquake zone 8 e is the smallest of the 8° MCS earthquake zones. It lies in the Municipality of Ilirska Bistrica on the border with Croatia. It has an area of 3,300 ha. which represents only 0.2% of the surface of Slovenia. It has just 806 people, the smallest number of all seventeen earthquake zones. Earthquake zone 8 f stretches across the municipalities of Loška dolina, Cerklje, and parts of Pivka and Ilirska Bistrica. It is characteristic of this zone that there are high Dinaric karst plateaus here with numerous karst phenomena. It measures 26,682 ha. or 1.3% of Slovenia, and it had 5,245 people or 0.3% of the population of Slovenia.

Earthquake zone 8 g is the largest 8° MCS earthquake zone and could simply be called the “Ljubljana Earthquake Zone” since it covers the greater part of the Ljubljana Basin, the whole of the Ljubljana Barje moor with its margins, the eastern part of the Sava River highlands, and the foothills of the Kamniško-Savinjske Alps. It is characterized by great geographical diversity and interweaving of landscape characteristics; in short, it is the junction between the southern Dinaric mountain system and the northern alpine environment. This is Slovenia's central area with a great concentration of population and various functions vital for the country. It covers some 169,222 ha. or 8.3% of the surface of Slovenia, and it had 463,495 people or some 23.6% of the population of Slovenia, that is, almost a quarter. More or less in the center of this zone is Ljubljana, for which a detailed microseismic regionalization has been elaborated that for a large part of the city's surface area predicts a 9° MCS earthquake according to the 500 year return period. This is shown in detail in figures 7 and it is not the subject of detailed study in the framework of this article. However, at this point and in this case specifically, it is worth noting the importance of internally structuring individual seismic zones, the basic aim of more detailed seismic or microseismic regionalization.

Earthquake zone 8 h is known as the “Dolenjske Toplice Earthquake Zone” and is almost completely within the Municipality of Novo mesto with only its very northern part reaching into the Municipality of Trebnje. Numerous faults run across this zone, and it is also known for other interesting tectonic phenomena. It covers 13,077 ha. or 0.7% of the surface of Slovenia, Together with the southern 8° MCS 8 k zone it has the characteristics of the earthquake activity along the western edge of the Dinaric mountain system.

Earthquake zone 8 i is known as the “Kozjansko Earthquake Zone.” Its central part stretches across the Municipality of Šentjur pri Celju; it reaches into the municipalities of Šmarje pri Jelšah, Laško, and Štore and touches the municipalities of Celje, Vojnik, and Slovenske Konjice. It covers 25,913 ha. or 1.3% of the surface of Slovenia and has 21,523 people or 1.1% of the population of Slovenia.

For earthquake zone 8 j, the name “Krško-Brežice Earthquake Zone” has become recognized. After the Ljubljana Earthquake Zone (8 g), this is the second largest 8° MCS earthquake zone. It covers 61,587 ha. or 3.0% of the surface of Slovenia, and it had 53,677 people or 2.7% of the population of Slovenia. This zone borders on neighbouring Croatia and covers the Municipality of Brežice completely and partially the municipalities of Krško, Kozje, and Podčetrtek.

Figure 4: Seismological map of Slovenia for the 500 year return period with seismic zones whose numbering denotes the highest expected MCS degree, with distribution and size of settlements (M 1 : 1,300,000).

Slika 4: Seizmološka karta Slovenije za povratno periodo 500 let s seizmičnimi območji, v katerih številka označuje največjo pričakovano MCS stopnjo, ter z razporeditvijo in velikostjo naselij (M 1 : 1,300,000).

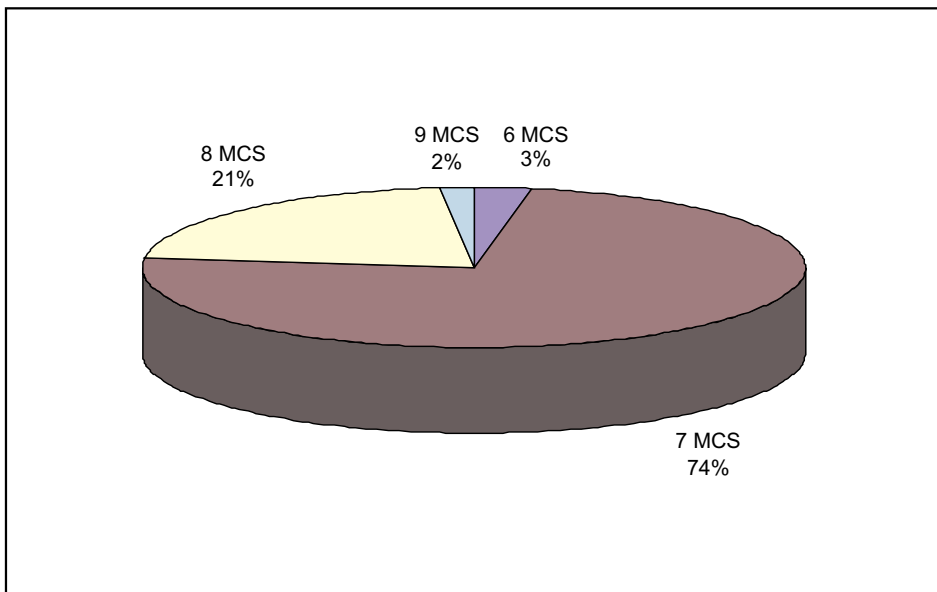


Figure 5: Proportion of surfaces of individual seismic MCS zones in Slovenia according to the 1987 map of seismic zones.  
Slika 5: Deleži površin posameznih seizmičnih MCS območij v Sloveniji po karti seizmičnih območij iz leta 1987.

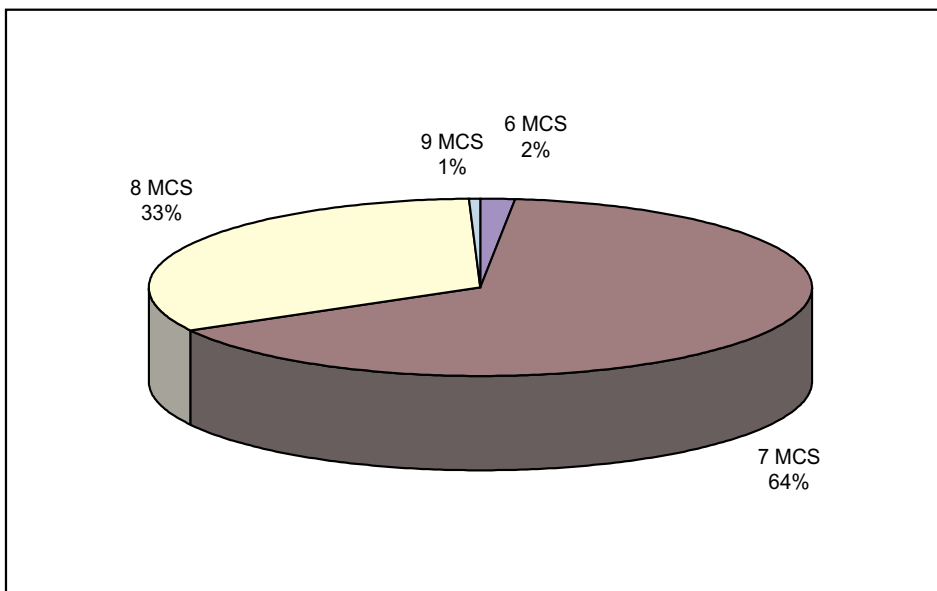
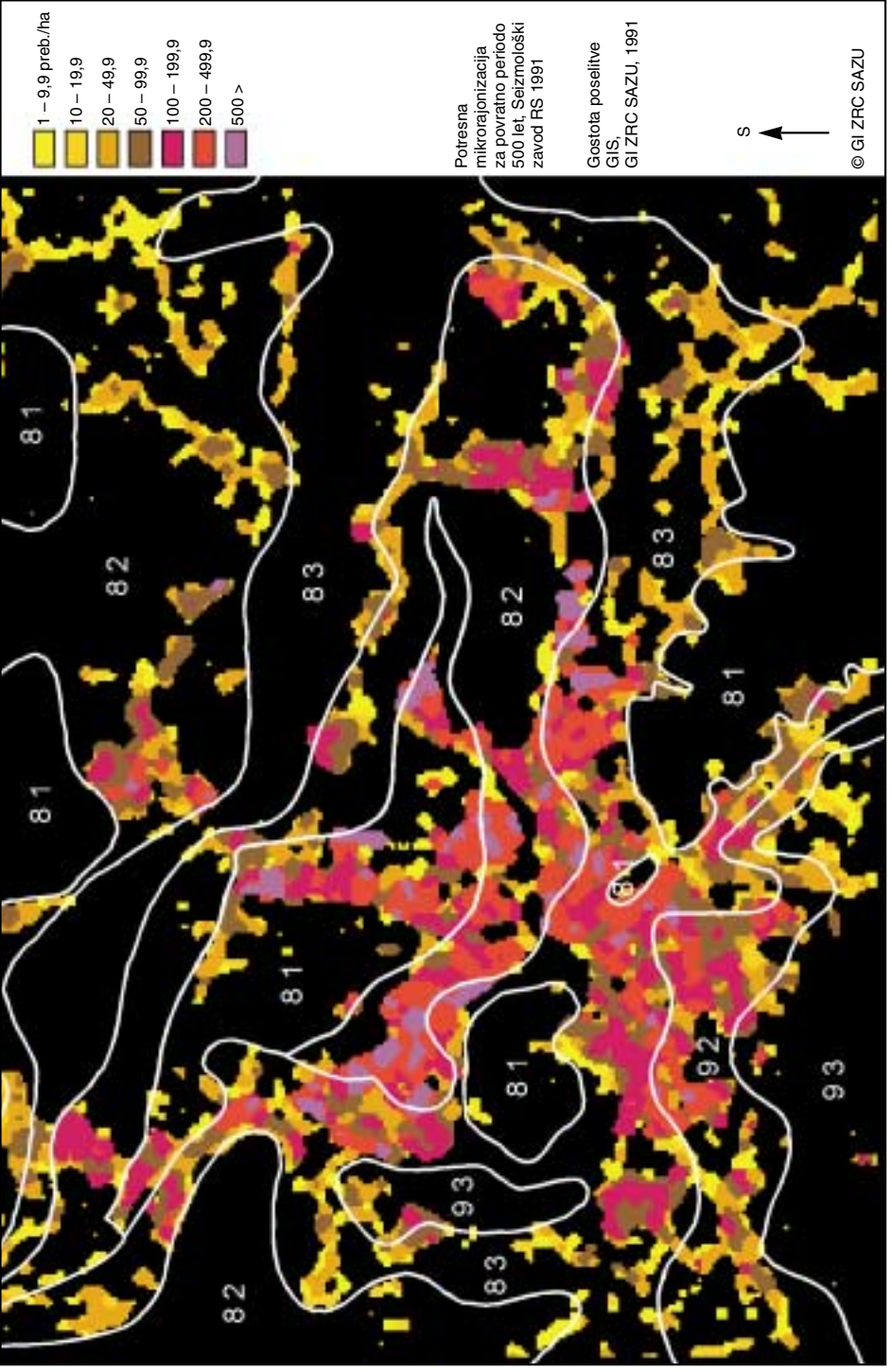


Figure 6: Proportion of population in 1991 according to MCS zones.  
Slika 6: Deleži prebivalstva leta 1991 po MCS območjih.

Figure 7: MCS areas and density of population per ha in Ljubljana.  
Slika 7: MCS območja in gostota poselitve v Ljubljani.



Earthquake zone 8 k is called the “Bela krajina Earthquake Zone.” It stretches across part of the municipalities of Semič, Metlika, and Črnomelj. Across the Kolpa River it reaches into neighbouring Croatia. It is known for relatively frequent but not very destructive earthquake activity. It covers 39,303 ha. or 1.9% of the surface of Slovenia, and it had 25,216 people or 1.3% of the population of Slovenia. There is only one undivided 7° MCS earthquake zone that stretches practically across the whole of Slovenia. It covers 1,502,247 ha. or 74.1%, that is, almost three quarters of the territory of Slovenia where in 1991 1,284,614 people or 65.3% of the population of Slovenia lived, almost two thirds of the total Slovene population.

In earthquake zone 6 a only earthquake effects to 6° MCS can be expected. We can call it the “Dravograd Earthquake Zone.” It covers parts of the municipalities of Dravograd, Muta, Vuzenica, Radlje ob Dravi, and Podvelka-Ribnica. It measures 18,299 ha. or 0.9% of the surface of Slovenia and had 13,108 people or 0.7% of the population of Slovenia.

Earthquake zone 6 b is the 6° MCS “Prekmurje Earthquake Zone” which contains the whole of the Goričko region with the municipalities of Hodoš-Šalovci/Hodos-Šalovci and Gornji Petrovci and parts of the municipalities of Kuzma, Rogaševci, Puconci, Moravske Toplice, and Kobilje. Its surface area is 37,020 ha. or 1.8% of the surface of Slovenia. In 1991 it had 17,514 people or 0.9% of the population of Slovenia.

The last two earthquake zones, 6 a and 6 b, are the least threatened earthquake zones where we do not expect major earthquake effects and together cover 55,319 ha. or only 2.7% of the surface of Slovenia. In 1991, 30,622 people or 1.6% of the population of Slovenia lived here.

### 3. Assessment of Earthquake Threat to Municipalities in Slovenia

By combining the layer of seismic zones with the layer of municipalities in the Geographical Information System, we determined an assessment of the earthquake threat to all the municipalities in Slovenia. Because the surface areas of the municipalities in the Geographical Information System are rastered to a 100 × 100 meter or one hectare degree of accuracy, in some cases there are minor deviations from the actual surface areas of the municipalities.

Calculations of surface areas and proportions of surface areas of the municipalities are given according to individual MCS zones in Table 2 in alphabetical order, and in Table 3 the municipalities are sorted according to their proportion of surface areas of specific MCS degrees. In first place are municipalities with the largest proportion of surface area in earthquake zones with the highest level of earthquake threat while in last place are municipalities with the largest proportion of surface area in earthquake zones with the lowest level of earthquake threat.

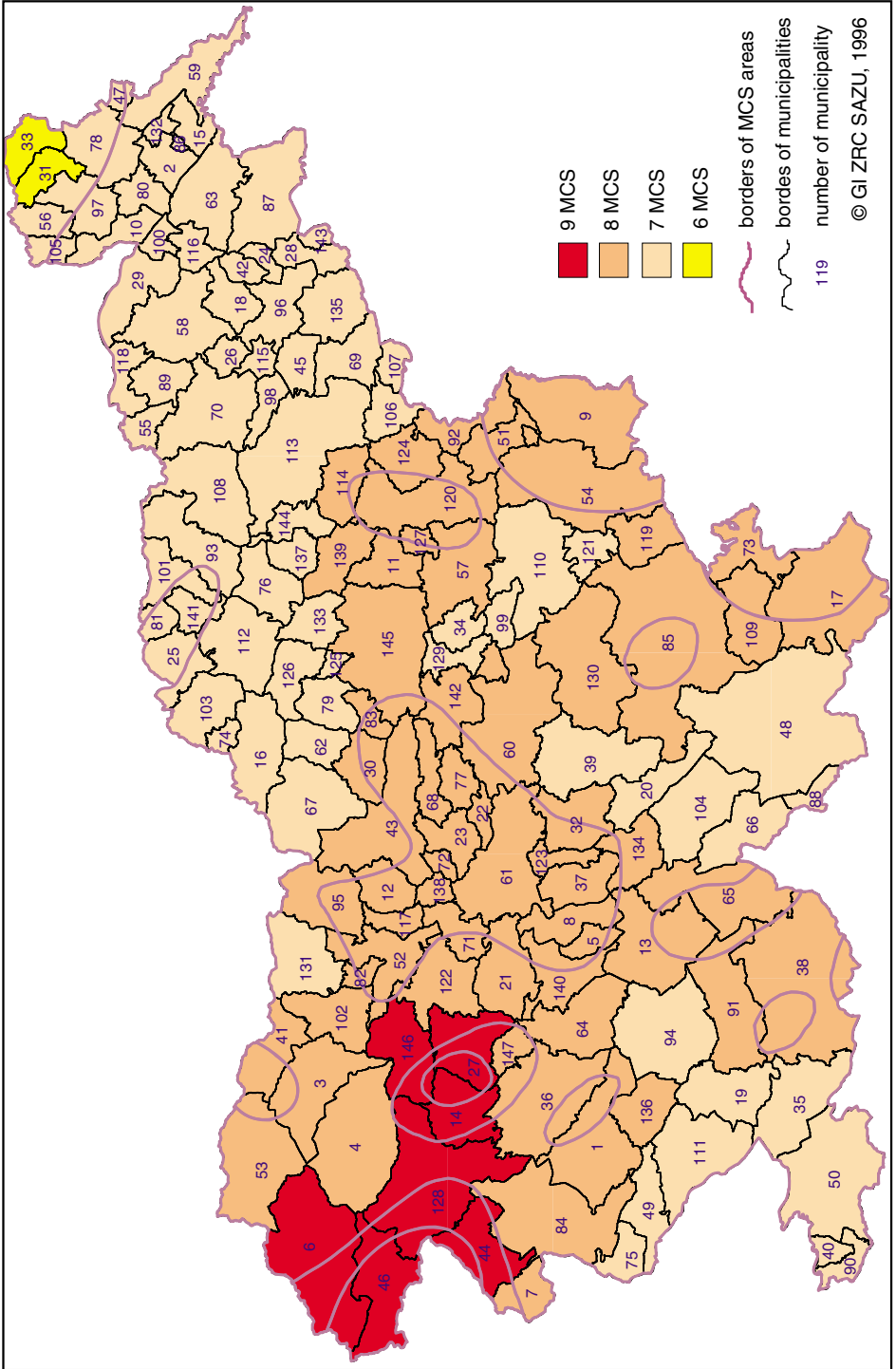
From this perspective, the Municipality of Kobarid has the highest level of earthquake threat, having more than four fifths of its territory in a 9° MCS earthquake zone. It is followed by the municipalities of Cerkno, Gorenja vas-Poljane, Kanal, Bovec, Tolmin, and Železniki. Thus only seven municipalities or 5% of all the municipalities in Slovenia have part of their territory in a 9° MCS earthquake zone.

If we consider 8° and 9° MCS earthquake zones together, the most threatened municipalities are Brežice, Dol pri Ljubljani, Domžale, Ig, Lukovica, Mengeš, Metlika, Moravče, Šenčur, Škofljica, and Vodice since they have their entire territories in 8° MCS earthquake zones.

The municipalities of Gornji Petrovci and Hodoš-Šalovci have the lowest level of earthquake threat since they are totally within 6° MCS earthquake zones.

To determine the mean or average earthquake threat to the surface of municipalities, we calculated a coefficient of earthquake threat to surfaces, giving a weight of 3 to 9° MCS earthquake zones, of 2 to 8° MCS earthquake zones, of 1 to the 7° MCS earthquake zone, and of 0 to 6° MCS earthquake

Figure 8: Highest expected degree MCS by municipalities for the 500 year return period (M 1 : 1,300,000).  
Slika 8: Največja pričakovana MCS stopnja po občinah za 500 letno povratno periodo (M 1 : 1,300,000).





zones. We divided the sums by the total surface area of the municipalities and divided the resulting coefficient again, this time with the largest possible coefficient so that the final values of the coefficients of earthquake threat to the surface areas were distributed between 0 and 1. Thus municipalities with their total territory in a 9° MCS zone have a coefficient of earthquake threat of 1, municipalities with their total surface area in a 6° MCS zone have a coefficient of earthquake threat of 0, and the remaining have coefficient values in between.

The municipality of Kobarid has the highest coefficient of earthquake threat to its surface area (0.9307), followed by the municipalities of Cerkno (0.7096) and Kanal (0.6789). The coefficient of earthquake threat for the whole of Slovenia amounts to 0.4074. Only forty-six municipalities have a higher coefficient of earthquake threat, while 101 have lower coefficients. The municipalities of Gornji Petrovci and Hodoš-Šalovci have the lowest coefficient, both 0.0000.

Similar to the determination of the mean or average earthquake threat to the surface areas of municipalities, we also calculated the coefficient of earthquake threat to population, giving a weight of 3 to the population in 9° MCS earthquake zones, of 2 in 8° MCS earthquake zones, of 1 in the 7° MCS earthquake zone, and of 0 in 6° MCS earthquake zones. We divided the sums by the total population of the municipalities and divided the resulting coefficient again, this time with the highest possible coefficient so that the final values of the coefficients of earthquake threat to the population were distributed between 0 and 1. Thus municipalities with their total territory in a 9° MCS zone have a coefficient of earthquake threat to the population of 1, municipalities with their total surface area in a 6° MCS zone have a coefficient of earthquake threat to the population of 0, and the remaining have coefficient values in between.

The Municipality of Kobarid has the highest coefficient of earthquake threat to the population (1.0000) since its entire population lives in the 9° MCS earthquake zone, followed by the municipalities of Cerkno (0.8289), Kanal (0.6853), and Bovec (0.6810). The coefficient of earthquake threat to the population of Slovenia is 0.4403. Only forty-one municipalities have a higher coefficient of earthquake threat to population while 106 municipalities have lower coefficients. The municipalities of Gornji Petrovci, Hodoš-Šalovci, Kobilje, and Vuzenica have the lowest coefficient of earthquake threat to population, all 0.0000. The coefficient applies to the population of municipalities according to the census of 1991.

Municipalities where the coefficient of earthquake threat to population is higher than the coefficient of earthquake threat to surface areas have a higher density of population in areas with higher MCS degrees than in areas with lower MCS degrees, which from the viewpoint of earthquake threat is an inappropriate distribution of population. The coefficient of earthquake threat to surface areas and the coefficient of earthquake threat to population are relative indicators of earthquake threat since they illustrate relative comparisons between municipalities. Thus one municipality may have higher coefficients than another although in the absolute sense more surface area in the second lies in a 9° MCS zone, or in the absolute sense more people live in the 9° MCS zone in the second municipality than in the first.

TABLE 2: SURFACE AREAS AND PROPORTIONS OF MUNICIPALITIES IN SLOVENIA ACCORDING TO MCS ZONES (MUNICIPALITIES ARE LISTED IN ALPHABETICAL ORDER).  
PREGLEDNICA 2: POVRŠINE IN DELEŽI OBČIN SLOVENIJE PO MCS OBMOČJIH (OBČINE SO RAZVRŠČENE PO ABECEDNEM VRSTNEM REDU).

Municipality	9° MCS in ha.	9° MCS in %	8° MCS in ha.	8° MCS in %	7° MCS in ha.	7° MCS in %	6° MCS in ha.	6° MCS in %	Total in ha.
Ajdovščina	0	0.00	5214	20.65	20034	79.35	0	0.00	25248
Beltinci	0	0.00	0	0.00	6505	100.00	0	0.00	6505
Bled	0	0.00	3081	14.93	17561	85.07	0	0.00	20642
Bohinj	0	0.00	65	0.21	30720	99.79	0	0.00	30785
Borovnica	0	0.00	3438	82.39	735	17.61	0	0.00	4173
Bovec	5640	15.09	9693	25.94	22033	58.97	0	0.00	37366
Brda	0	0.00	2020	27.61	5296	72.39	0	0.00	7316
Brezovica	0	0.00	9042	96.36	342	3.64	0	0.00	9384
Brežice	0	0.00	26993	100.00	0	0.00	0	0.00	26993

Municipality	9° MCS in ha.	9° MCS in %	8° MCS in ha.	8° MCS in %	7° MCS in ha.	7° MCS in %	6° MCS in ha.	6° MCS in %	Total in ha.
Cankova-Tišina	0	0.00	0	0.00	7217	100.00	0	0.00	7217
Cerklje na Gorenjskem	0	0.00	6693	82.80	1390	17.20	0	0.00	8083
Cerknica	0	0.00	9269	37.47	15469	62.53	0	0.00	24738
Cerkno	4024	29.59	7302	53.70	2271	16.70	0	0.00	13597
Črenšovci	0	0.00	0	0.00	15988	100.00	0	0.00	15988
Črna na Koroškem	0	0.00	0	0.00	5506	100.00	0	0.00	5506
Črnomelj	0	0.00	21959	64.24	12225	35.76	0	0.00	34184
Destrinik-Trnovska vas	0	0.00	0	0.00	7800	100.00	0	0.00	7800
Divča	0	0.00	0	0.00	14971	100.00	0	0.00	14971
Dobropolje	0	0.00	0	0.00	11821	100.00	0	0.00	11821
Dobrova-Horjul-									
Polhov Gradec	0	0.00	3175	20.99	11949	79.01	0	0.00	15124
Dol pri Ljubljani	0	0.00	3333	100.00	0	0.00	0	0.00	3333
Domžale	0	0.00	8090	100.00	0	0.00	0	0.00	8090
Dornava	0	0.00	0	0.00	2843	100.00	0	0.00	2843
Dravograd	0	0.00	0	0.00	3984	37.95	6515	62.05	10499
Duplek	0	0.00	0	0.00	4005	100.00	0	0.00	4005
Gorenja vas-Poljane	4282	27.74	5433	35.19	5723	37.07	0	0.00	15438
Gorišnica	0	0.00	0	0.00	6136	100.00	0	0.00	6136
Gornja Radgona	0	0.00	0	0.00	12805	100.00	0	0.00	12805
Gornji Grad	0	0.00	4356	48.30	4663	51.70	0	0.00	9019
Gornji Petrovci	0	0.00	0	0.00	0	0.00	6693	100.00	6693
Grosuplje	0	0.00	5942	44.43	7433	55.57	0	0.00	13375
Hodoš-Šalovci	0	0.00	0	0.00	0	0.00	7628	100.00	7628
Hrastnik	0	0.00	0	0.00	5865	100.00	0	0.00	5865
Hrpelje-Kozina	0	0.00	0	0.00	19342	100.00	0	0.00	19342
Idrija	0	0.00	9349	32.25	19642	67.75	0	0.00	28991
Ig	0	0.00	9781	100.00	0	0.00	0	0.00	9781
Ilirska Bistrica	0	0.00	11921	24.84	36068	75.16	0	0.00	47989
Ivančna Gorica	0	0.00	0	0.00	22724	100.00	0	0.00	22724
Izola/Isola	0	0.00	0	0.00	2870	100.00	0	0.00	2870
Jesenice	0	0.00	6020	51.31	5712	48.69	0	0.00	11732
Juršinci	0	0.00	0	0.00	3513	100.00	0	0.00	3513
Kamnik	0	0.00	14365	50.38	14151	49.62	0	0.00	28516
Kanal	3146	21.59	8813	60.48	2613	17.93	0	0.00	14572
Kidričevo	0	0.00	0	0.00	6885	100.00	0	0.00	6885
Kobarid	15643	82.67	2625	13.87	654	3.46	0	0.00	18922
Kobilje	0	0.00	0	0.00	546	27.59	1433	72.41	1979
Kočevje	0	0.00	0	0.00	59534	100.00	0	0.00	59534
Komen	0	0.00	0	0.00	10221	100.00	0	0.00	10221
Kozje	0	0.00	4362	48.51	4630	51.49	0	0.00	8992
Kranjska Gora	0	0.00	2492	9.76	23040	90.24	0	0.00	25532
Krško	0	0.00	26444	76.90	7942	23.10	0	0.00	34386
Kungota	0	0.00	0	0.00	4904	100.00	0	0.00	4904
Kuzma	0	0.00	0	0.00	616	10.25	5396	89.75	6012
Laško	0	0.00	3500	17.74	16227	82.26	0	0.00	19727
Lenart	0	0.00	0	0.00	20384	100.00	0	0.00	20384
Lendava/Lendva	0	0.00	0	0.00	15067	98.97	157	1.03	15224
Litija	0	0.00	4684	14.56	27496	85.44	0	0.00	32180
Ljubno	0	0.00	0	0.00	7802	100.00	0	0.00	7802
Ljutomer	0	0.00	0	0.00	17376	100.00	0	0.00	17376
Logatec	0	0.00	28	0.16	17301	99.84	0	0.00	17329
Loška dolina	0	0.00	14122	59.25	9711	40.75	0	0.00	23833
Loški Potok	0	0.00	0	0.00	13444	100.00	0	0.00	13444
Luče	0	0.00	0	0.00	21343	100.00	0	0.00	21343
Lukovica	0	0.00	7512	100.00	0	0.00	0	0.00	7512

Municipality	9° MCS in ha.	9° MCS in %	8° MCS in ha.	8° MCS in %	7° MCS in ha.	7° MCS in %	6° MCS in ha.	6° MCS in %	Total in ha.
Majšperk	0	0.00	0	0.00	10875	100.00	0	0.00	10875
Medvode	0	0.00	4630	60.69	2999	39.31	0	0.00	7629
Mengeš	0	0.00	2234	100.00	0	0.00	0	0.00	2234
Metlika	0	0.00	10714	100.00	0	0.00	0	0.00	10714
Mežica	0	0.00	0	0.00	2612	100.00	0	0.00	2612
Miren-Kostanjevica	0	0.00	0	0.00	6275	100.00	0	0.00	6275
Mislinja	0	0.00	0	0.00	11222	100.00	0	0.00	11222
Moravče	0	0.00	6128	100.00	0	0.00	0	0.00	6128
Moravske Toplice	0	0.00	0	0.00	5628	39.03	8792	60.97	14420
Mozirje	0	0.00	0	0.00	8568	100.00	0	0.00	8568
Muta	0	0.00	0	0.00	497	12.82	3379	87.18	3876
Naklo	0	0.00	1529	55.30	1236	44.70	0	0.00	2765
Nazarje	0	0.00	2182	52.95	1939	47.05	0	0.00	4121
Odranci	0	0.00	0	0.00	597	100.00	0	0.00	597
Ormož	0	0.00	0	0.00	21231	100.00	0	0.00	21231
Osilnica	0	0.00	0	0.00	3628	100.00	0	0.00	3628
Pesnica	0	0.00	0	0.00	7545	100.00	0	0.00	7545
Piran/Pirano	0	0.00	0	0.00	4423	100.00	0	0.00	4423
Pivka	0	0.00	3633	16.43	18483	83.57	0	0.00	22116
Podčetrtek	0	0.00	3771	40.83	5465	59.17	0	0.00	9236
Podvelka-Ribnica	0	0.00	0	0.00	15333	93.33	1095	6.67	16428
Postojna	0	0.00	0	0.00	26750	100.00	0	0.00	26750
Preddvor	0	0.00	6504	41.78	9064	58.22	0	0.00	15568
Puconci	0	0.00	0	0.00	5878	55.04	4802	44.96	10680
Rače-Fram	0	0.00	0	0.00	5160	100.00	0	0.00	5160
Radeče	0	0.00	0	0.00	5194	100.00	0	0.00	5194
Radenci	0	0.00	0	0.00	3374	100.00	0	0.00	3374
Radlje ob Dravi	0	0.00	0	0.00	6462	69.94	2778	30.06	9240
Radovljica	0	0.00	267	2.06	12723	97.94	0	0.00	12990
Ravne-Prevalje	0	0.00	0	0.00	12132	100.00	0	0.00	12132
Ribnica	0	0.00	0	0.00	20306	100.00	0	0.00	20306
Rogaševci	0	0.00	0	0.00	1874	46.93	2119	53.07	3993
Rogaška Slatina	0	0.00	0	0.00	7162	100.00	0	0.00	7162
Rogatec	0	0.00	0	0.00	3949	100.00	0	0.00	3949
Ruše	0	0.00	0	0.00	20972	100.00	0	0.00	20972
Semič	0	0.00	6329	43.21	8317	56.79	0	0.00	14646
Sevnica	0	0.00	0	0.00	27208	100.00	0	0.00	27208
Sežana	0	0.00	0	0.00	21684	100.00	0	0.00	21684
Slovenska Bistrica	0	0.00	0	0.00	36739	100.00	0	0.00	36739
Slovenske Konjice	0	0.00	1027	10.35	8897	89.65	0	0.00	9924
Starše	0	0.00	0	0.00	3385	100.00	0	0.00	3385
Sveti Jurij	0	0.00	0	0.00	5111	100.00	0	0.00	5111
Šenčur	0	0.00	4292	100.00	0	0.00	0	0.00	4292
Šentilj	0	0.00	0	0.00	6505	100.00	0	0.00	6505
Šentjernej	0	0.00	17	0.18	9599	99.82	0	0.00	9616
Šentjur pri Celju	0	0.00	17430	72.79	6517	27.21	0	0.00	23947
Škocjan	0	0.00	0	0.00	6038	100.00	0	0.00	6038
Škofja Loka	0	0.00	902	6.01	14105	93.99	0	0.00	15007
Škofljica	0	0.00	4327	100.00	0	0.00	0	0.00	4327
Šmarje pri Jelšah	0	0.00	1881	17.72	8734	82.28	0	0.00	10615
Šmartno ob Paki	0	0.00	0	0.00	1799	100.00	0	0.00	1799
Šoštanj	0	0.00	0	0.00	9464	100.00	0	0.00	9464
Štore	0	0.00	1645	55.02	1345	44.98	0	0.00	2990
Tolmin	2697	7.12	15161	40.04	20011	52.84	0	0.00	37869
Trbovlje	0	0.00	0	0.00	5805	100.00	0	0.00	5805
Trebnje	0	0.00	296	0.95	30846	99.05	0	0.00	31142

Municipality	9° MCS in ha.	9° MCS in %	8° MCS in ha.	8° MCS in %	7° MCS in ha.	7° MCS in %	6° MCS in ha.	6° MCS in %	Total in ha.
Tržič	0	0.00	0	0.00	15538	100.00	0	0.00	15538
Turnišče	0	0.00	0	0.00	2257	100.00	0	0.00	2257
Velike Lašče	0	0.00	2020	19.71	8229	80.29	0	0.00	10249
Videm	0	0.00	0	0.00	12817	100.00	0	0.00	12817
Vipava	0	0.00	79	0.76	10353	99.24	0	0.00	10432
Vitanje	0	0.00	0	0.00	5941	100.00	0	0.00	5941
Vodice	0	0.00	3111	100.00	0	0.00	0	0.00	3111
Vojnik	0	0.00	188	1.76	10515	98.24	0	0.00	10703
Vrhnika	0	0.00	4483	35.76	8052	64.24	0	0.00	12535
Vuzenica	0	0.00	0	0.00	716	14.18	4335	85.82	5051
Zagorje ob Savi	0	0.00	3839	26.11	10865	73.89	0	0.00	14704
Zavrč	0	0.00	0	0.00	1930	100.00	0	0.00	1930
Zreče	0	0.00	0	0.00	6585	100.00	0	0.00	6585
Žalec	0	0.00	3228	9.63	30303	90.37	0	0.00	33531
Železniki	900	5.63	3377	21.12	11709	73.25	0	0.00	15986
Žiri	0	0.00	4294	96.69	147	3.31	0	0.00	4441
Celje	0	0.00	242	2.60	9078	97.40	0	0.00	9320
Koper/Capodistria	0	0.00	0	0.00	31120	100.00	0	0.00	31120
Kranj	0	0.00	11869	79.84	2997	20.16	0	0.00	14866
Ljubljana	0	0.00	26877	98.08	527	1.92	0	0.00	27404
Maribor	0	0.00	0	0.00	21394	100.00	0	0.00	21394
Murska Sobota	0	0.00	0	0.00	6324	100.00	0	0.00	6324
Nova Gorica	0	0.00	525	1.63	31709	98.37	0	0.00	32234
Novo mesto	0	0.00	13082	21.07	49021	78.93	0	0.00	62103
Ptuj	0	0.00	0	0.00	11939	100.00	0	0.00	11939
Slovenj Gradec	0	0.00	0	0.00	17121	98.86	197	1.14	17318
Velenje	0	0.00	0	0.00	8347	100.00	0	0.00	8347
Slovenia	36332	1.79	433229	21.37	1502247	74.11	55319	2.73	2027127

TABLE 3: PROPORTIONS OF MUNICIPALITIES IN SLOVENIA ACCORDING TO MCS ZONES (MUNICIPALITIES ARE SORTED ACCORDING TO PROPORTION OF SURFACE AREA FROM HIGHEST TO LOWEST MCS DEGREE).  
 PREGLEDNICA 3: DELEŽI OBČIN SLOVENIJE PO MCS OBMOČJIH (OBČINE SO RAZVRŠČENE GLEDE NA DELEŽ NJIHOVE POVRŠINE OD NAJVIŠJE DO NAJNIŽJE STOPNJE MCS).

Municipality	9° MCS in %	8° MCS in %	7° MCS in %	6° MCS in %
Kobarid	82.67	13.87	3.46	0.00
Cerkno	29.59	53.70	16.70	0.00
Gorenja vas-Poljane	27.74	35.19	37.07	0.00
Kanal	21.59	60.48	17.93	0.00
Bovec	15.09	25.94	58.97	0.00
Tolmin	7.12	40.04	52.84	0.00
Železniki	5.63	21.12	73.25	0.00
Brežice	0.00	100.00	0.00	0.00
Dol pri Ljubljani	0.00	100.00	0.00	0.00
Domžale	0.00	100.00	0.00	0.00
Ig	0.00	100.00	0.00	0.00
Lukovica	0.00	100.00	0.00	0.00
Mengeš	0.00	100.00	0.00	0.00
Metlika	0.00	100.00	0.00	0.00
Moravče	0.00	100.00	0.00	0.00
Šenčur	0.00	100.00	0.00	0.00
Škofljica	0.00	100.00	0.00	0.00
Vodice	0.00	100.00	0.00	0.00
Ljubljana	0.00	98.08	1.92	0.00

Municipality	9° MCS in %	8° MCS in %	7° MCS in %	6° MCS in %
Žiri	0.00	96.69	3.31	0.00
Brezovica	0.00	96.36	3.64	0.00
Cerklje na Gorenjskem	0.00	82.80	17.20	0.00
Borovnica	0.00	82.39	17.61	0.00
Kranj	0.00	79.84	20.16	0.00
Krško	0.00	76.90	23.10	0.00
Šentjur pri Celju	0.00	72.79	27.21	0.00
Črnomelj	0.00	64.24	35.76	0.00
Medvode	0.00	60.69	39.31	0.00
Loška dolina	0.00	59.25	40.75	0.00
Naklo	0.00	55.30	44.70	0.00
Štore	0.00	55.02	44.98	0.00
Nazarje	0.00	52.95	47.05	0.00
Jesenice	0.00	51.31	48.69	0.00
Kamnik	0.00	50.38	49.62	0.00
Kozje	0.00	48.51	51.49	0.00
Gornji Grad	0.00	48.30	51.70	0.00
Grosuplje	0.00	44.43	55.57	0.00
Semič	0.00	43.21	56.79	0.00
Preddvor	0.00	41.78	58.22	0.00
Podčetrtek	0.00	40.83	59.17	0.00
Cerknica	0.00	37.47	62.53	0.00
Vrhnika	0.00	35.76	64.24	0.00
Idrija	0.00	32.25	67.75	0.00
Brda	0.00	27.61	72.39	0.00
Zagorje ob Savi	0.00	26.11	73.89	0.00
Ilirska Bistrica	0.00	24.84	75.16	0.00
Novo mesto	0.00	21.07	78.93	0.00
Dobrova-Horjul-Polhov Gradec	0.00	20.99	79.01	0.00
Ajdovščina	0.00	20.65	79.35	0.00
Velike Lašče	0.00	19.71	80.29	0.00
Laško	0.00	17.74	82.26	0.00
Šmarje pri Jelšah	0.00	17.72	82.28	0.00
Pivka	0.00	16.43	83.57	0.00
Bled	0.00	14.93	85.07	0.00
Litija	0.00	14.56	85.44	0.00
Slovenske Konjice	0.00	10.35	89.65	0.00
Kranjska Gora	0.00	9.76	90.24	0.00
Žalec	0.00	9.63	90.37	0.00
Škofja Loka	0.00	6.01	93.99	0.00
Celje	0.00	2.60	97.40	0.00
Radovljica	0.00	2.06	97.94	0.00
Vojnik	0.00	1.76	98.24	0.00
Nova Gorica	0.00	1.63	98.37	0.00
Trebnje	0.00	0.95	99.05	0.00
Vipava	0.00	0.76	99.24	0.00
Bohinj	0.00	0.21	99.79	0.00
Šentjernej	0.00	0.18	99.82	0.00
Logatec	0.00	0.16	99.84	0.00
Beltinci	0.00	0.00	100.00	0.00
Čankova-Tišina	0.00	0.00	100.00	0.00
Črenšovci	0.00	0.00	100.00	0.00
Črna na Koroškem	0.00	0.00	100.00	0.00
Destrinik-Trnovska vas	0.00	0.00	100.00	0.00
Divača	0.00	0.00	100.00	0.00
Dobropolje	0.00	0.00	100.00	0.00
Dornava	0.00	0.00	100.00	0.00

Municipality	9° MCS in %	8° MCS in %	7° MCS in %	6° MCS in %
Duplek	0.00	0.00	100.00	0.00
Gorišnica	0.00	0.00	100.00	0.00
Gornja Radgona	0.00	0.00	100.00	0.00
Hrastnik	0.00	0.00	100.00	0.00
Hrpelje-Kozina	0.00	0.00	100.00	0.00
Ivančna Gorica	0.00	0.00	100.00	0.00
Izola/Isola	0.00	0.00	100.00	0.00
Juršinci	0.00	0.00	100.00	0.00
Kidričevo	0.00	0.00	100.00	0.00
Kočevo	0.00	0.00	100.00	0.00
Komen	0.00	0.00	100.00	0.00
Kungota	0.00	0.00	100.00	0.00
Lenart	0.00	0.00	100.00	0.00
Ljubno	0.00	0.00	100.00	0.00
Ljutomer	0.00	0.00	100.00	0.00
Loški Potok	0.00	0.00	100.00	0.00
Luče	0.00	0.00	100.00	0.00
Majšperk	0.00	0.00	100.00	0.00
Mežica	0.00	0.00	100.00	0.00
Miren-Kostanjevica	0.00	0.00	100.00	0.00
Mislinja	0.00	0.00	100.00	0.00
Mozirje	0.00	0.00	100.00	0.00
Odranci	0.00	0.00	100.00	0.00
Ormož	0.00	0.00	100.00	0.00
Osilnica	0.00	0.00	100.00	0.00
Pesnica	0.00	0.00	100.00	0.00
Piran/Pirano	0.00	0.00	100.00	0.00
Postojna	0.00	0.00	100.00	0.00
Rače-Fram	0.00	0.00	100.00	0.00
Radeče	0.00	0.00	100.00	0.00
Radenci	0.00	0.00	100.00	0.00
Ravne-Prevalje	0.00	0.00	100.00	0.00
Ribnica	0.00	0.00	100.00	0.00
Rogaška Slatina	0.00	0.00	100.00	0.00
Rogatec	0.00	0.00	100.00	0.00
Ruše	0.00	0.00	100.00	0.00
Sevnica	0.00	0.00	100.00	0.00
Sežana	0.00	0.00	100.00	0.00
Slovenska Bistrica	0.00	0.00	100.00	0.00
Starše	0.00	0.00	100.00	0.00
Sveti Jurij	0.00	0.00	100.00	0.00
Šentilj	0.00	0.00	100.00	0.00
Škocjan	0.00	0.00	100.00	0.00
Šmartno ob Paki	0.00	0.00	100.00	0.00
Šoštanj	0.00	0.00	100.00	0.00
Trbovlje	0.00	0.00	100.00	0.00
Tržič	0.00	0.00	100.00	0.00
Turnišče	0.00	0.00	100.00	0.00
Videm	0.00	0.00	100.00	0.00
Vitanje	0.00	0.00	100.00	0.00
Zavrč	0.00	0.00	100.00	0.00
Zreče	0.00	0.00	100.00	0.00
Koper/Capodistria	0.00	0.00	100.00	0.00
Maribor	0.00	0.00	100.00	0.00
Murska Sobota	0.00	0.00	100.00	0.00
Ptuj	0.00	0.00	100.00	0.00
Velenje	0.00	0.00	100.00	0.00

Municipality	9° MCS in %	8° MCS in %	7° MCS in %	6° MCS in %
Lendava/Lendva	0.00	0.00	98.97	1.03
Slovenj Gradec	0.00	0.00	98.86	1.14
Podvelka-Ribnica	0.00	0.00	93.33	6.67
Radlje ob Dravi	0.00	0.00	69.94	30.06
Puconci	0.00	0.00	55.04	44.96
Rogaševci	0.00	0.00	46.93	53.07
Moravske Toplice	0.00	0.00	39.03	60.97
Dravograd	0.00	0.00	37.95	62.05
Kobilje	0.00	0.00	27.59	72.41
Vuzenica	0.00	0.00	14.18	85.82
Muta	0.00	0.00	12.82	87.18
Kuzma	0.00	0.00	10.25	89.75
Gornji Petrovci	0.00	0.00	0.00	100.00
Hodoš-Šalovci	0.00	0.00	0.00	100.00

TABLE 4: COEFFICIENT OF EARTHQUAKE THREAT BY MUNICIPALITIES ACCORDING TO SURFACE AREA.  
 PREGLEDNICA 4: KOEFICIENT POTRESNE OGRÖZENOSTI PO OBČINAH GLEDE NA POVRŠINE.

Rank	Municipality	Coefficient	Rank	Municipality	Coefficient
1	Kobarid	0.9307	38	Preddvor	0.4726
2	Cerkno	0.7096	39	Podčetrtek	0.4694
3	Kanal	0.6789	40	Cerknica	0.4582
4	Brežice	0.6667	41	Vrhnika	0.4525
5	Dol pri Ljubljani	0.6667	42	Železniki	0.4413
6	Domžale	0.6667	43	Idrija	0.4408
7	Ig	0.6667	44	Brda	0.4254
8	Lukovica	0.6667	45	Zagorje ob Savi	0.4204
9	Mengeš	0.6667	46	Ilirska Bistrica	0.4161
10	Metlika	0.6667		<b>Slovenia</b>	<b>0.4074</b>
11	Moravče	0.6667	47	Novo mesto	0.4036
12	Šenčur	0.6667	48	Dobrova-Horjul-Polhov Gradec	0.4033
13	Škofljica	0.6667	49	Ajdovščina	0.4022
14	Vodice	0.6667	50	Velike Lašče	0.3990
15	Ljubljana	0.6603	51	Laško	0.3925
16	Žiri	0.6556	52	Šmarje pri Jelšah	0.3924
17	Brezovica	0.6545	53	Pivka	0.3881
18	Gorenja vas-Poljane	0.6356	54	Bled	0.3831
19	Cerklje na Gorenjskem	0.6093	55	Litija	0.3819
20	Borovnica	0.6080	56	Slovenske Konjice	0.3678
21	Kranj	0.5995	57	Kranjska Gora	0.3659
22	Krško	0.5897	58	Žalec	0.3654
23	Šentjur pri Celju	0.5760	59	Škofja Loka	0.3534
24	Črnomelj	0.5475	60	Celje	0.3420
25	Medvode	0.5356	61	Radovljica	0.3402
26	Loška dolina	0.5308	62	Vojnik	0.3392
27	Bovec	0.5204	63	Nova Gorica	0.3388
28	Naklo	0.5177	64	Trebnje	0.3365
29	Štore	0.5167	65	Vipava	0.3359
30	Tolmin	0.5143	66	Bohinj	0.3340
31	Nazarje	0.5098	67	Šentjernej	0.3339
32	Jesenice	0.5044	68	Logatec	0.3339
33	Kamnik	0.5013	69	Beltinci	0.3333
34	Kozje	0.4950	70	Čankova-Tišina	0.3333
35	Gornji Grad	0.4943	71	Črenšovci	0.3333
36	Grosuplje	0.4814	72	Črna na Koroškem	0.3333
37	Semič	0.4774	73	Destrič-Trnovska vas	0.3333

Rank	Municipality	Coefficient	Rank	Municipality	Coefficient
74	Divača	0.3333	111	Rogatec	0.3333
75	Dobropolje	0.3333	112	Ruše	0.3333
76	Dornava	0.3333	113	Sevnica	0.3333
77	Duplek	0.3333	114	Sežana	0.3333
78	Gorišnica	0.3333	115	Slovenska Bistrica	0.3333
79	Gornja Radgona	0.3333	116	Starše	0.3333
80	Hrastnik	0.3333	117	Sveti Jurij	0.3333
81	Hrpelje-Kozina	0.3333	118	Šentilj	0.3333
82	Ivančna Gorica	0.3333	119	Škocjan	0.3333
83	Izola/Isola	0.3333	120	Šmartno ob Paki	0.3333
84	Juršinci	0.3333	121	Šoštanj	0.3333
85	Kidričevo	0.3333	122	Trbovlje	0.3333
86	Kočevo	0.3333	123	Tržič	0.3333
87	Komen	0.3333	124	Turnišče	0.3333
88	Kungota	0.3333	125	Videm	0.3333
89	Lenart	0.3333	126	Vitanje	0.3333
90	Ljubno	0.3333	127	Zavrč	0.3333
91	Ljutomer	0.3333	128	Zreče	0.3333
92	Loški Potok	0.3333	129	Koper/Capodistria	0.3333
93	Luče	0.3333	130	Maribor	0.3333
94	Majšperk	0.3333	131	Murska Sobota	0.3333
95	Mežica	0.3333	132	Ptuj	0.3333
96	Miren-Kostanjevica	0.3333	133	Velenje	0.3333
97	Mislinja	0.3333	134	Lendava/Lendva	0.3299
98	Mozirje	0.3333	135	Slovenj Gradec	0.3295
99	Odranci	0.3333	136	Podvelka-Ribnica	0.3111
100	Ormož	0.3333	137	Radlje ob Dravi	0.2331
101	Oslinica	0.3333	138	Puconci	0.1835
102	Pesnica	0.3333	139	Rogaševci	0.1564
103	Piran/Pirano	0.3333	140	Moravske Toplice	0.1301
104	Postojna	0.3333	141	Dravograd	0.1265
105	Rače-Fram	0.3333	142	Kobilje	0.0920
106	Radeče	0.3333	143	Vuzenica	0.0473
107	Radenci	0.3333	144	Muta	0.0427
108	Ravne-Prevalje	0.3333	145	Kuzma	0.0342
109	Ribnica	0.3333	146	Gornji Petrovci	0.0000
110	Rogaška Slatina	0.3333	147	Hodoš-Salovci	0.0000

TABLE 5: PROPORTIONS OF POPULATION OF MUNICIPALITIES IN SLOVENIA ACCORDING TO MCS ZONES (MUNICIPALITIES ARE SORTED ACCORDING TO THE PROPORTION OF THEIR POPULATION FROM HIGHEST TO LOWEST MCS DEGREE).

PREGLEDNICA 5: DELEŽI PREBIVALSTVA OBČIN SLOVENIJE PO MCS OBMOČJIH (OBČINE SO RAZVRŠČENE GLEDE NA DELEŽ NJIHOVEGA PREBIVALSTVA OD NAJVIŠJE DO NAJNIŽJE STOPNJE MCS).

Municipality	9° MCS	8° MCS	7° MCS	6° MCS
Kobarid	100.00	0.00	0.00	0.00
Cerkno	55.48	37.70	6.82	0.00
Bovec	19.43	65.44	15.13	0.00
Gorenja vas-Poljane	16.36	46.57	37.07	0.00
Kanal	5.58	94.42	0.00	0.00
Tolmin	4.40	76.21	19.39	0.00
Železniki	3.87	4.50	91.63	0.00
Borovnica	0.00	100.00	0.00	0.00
Brezovica	0.00	100.00	0.00	0.00
Brežice	0.00	100.00	0.00	0.00
Dol pri Ljubljani	0.00	100.00	0.00	0.00



Municipality	9° MCS	8° MCS	7° MCS	6° MCS
Domžale	0.00	100.00	0.00	0.00
Ig	0.00	100.00	0.00	0.00
Lukovica	0.00	100.00	0.00	0.00
Mengeš	0.00	100.00	0.00	0.00
Metlika	0.00	100.00	0.00	0.00
Moravče	0.00	100.00	0.00	0.00
Šenčur	0.00	100.00	0.00	0.00
Škofljica	0.00	100.00	0.00	0.00
Vodice	0.00	100.00	0.00	0.00
Žiri	0.00	100.00	0.00	0.00
Ljubljana	0.00	99.95	0.05	0.00
Cerklje na Gorenjskem	0.00	96.99	3.01	0.00
Kranj	0.00	96.57	3.43	0.00
Črnomelj	0.00	93.69	6.31	0.00
Semič	0.00	88.74	11.26	0.00
Krško	0.00	88.23	11.77	0.00
Medvode	0.00	87.23	12.77	0.00
Gornji Grad	0.00	87.06	12.94	0.00
Šentjur pri Celju	0.00	85.91	14.09	0.00
Jesenice	0.00	80.26	19.74	0.00
Naklo	0.00	76.65	23.35	0.00
Grosuplje	0.00	76.57	23.43	0.00
Preddvor	0.00	73.07	26.93	0.00
Loška dolina	0.00	70.60	29.40	0.00
Ilirska Bistrica	0.00	59.68	40.32	0.00
Kozje	0.00	50.23	49.77	0.00
Kamnik	0.00	39.21	60.79	0.00
Podčetrtek	0.00	36.99	63.01	0.00
Štore	0.00	36.14	63.86	0.00
Dobrova-Horjul-Polhov Gradec	0.00	33.19	66.81	0.00
Vrhnika	0.00	32.92	67.08	0.00
Idrija	0.00	26.79	73.21	0.00
Nazarje	0.00	25.65	74.35	0.00
Šmarje pri Jelšah	0.00	17.11	82.89	0.00
Cerknica	0.00	16.22	83.78	0.00
Novo mesto	0.00	15.89	84.11	0.00
Litija	0.00	14.69	85.31	0.00
Velike Lašče	0.00	13.98	86.02	0.00
Kranjska Gora	0.00	11.32	88.68	0.00
Laško	0.00	10.81	89.19	0.00
Zagorje ob Savi	0.00	8.95	91.05	0.00
Ajdovščina	0.00	5.87	94.13	0.00
Brda	0.00	4.71	95.29	0.00
Žalec	0.00	4.15	95.85	0.00
Slovenske Konjice	0.00	1.82	98.18	0.00
Škofja Loka	0.00	1.12	98.88	0.00
Radovljica	0.00	0.58	99.42	0.00
Bled	0.00	0.30	99.70	0.00
Celje	0.00	0.27	99.73	0.00
Vojnik	0.00	0.16	99.84	0.00
Beltinci	0.00	0.00	100.00	0.00
Bohinj	0.00	0.00	100.00	0.00
Čankova-Tišina	0.00	0.00	100.00	0.00
Črna na Koroškem	0.00	0.00	100.00	0.00
Črenšovci	0.00	0.00	100.00	0.00
Destričnik-Trnovska vas	0.00	0.00	100.00	0.00
Divača	0.00	0.00	100.00	0.00

Municipality	9° MCS	8° MCS	7° MCS	6° MCS
Dobrepolje	0.00	0.00	100.00	0.00
Dornava	0.00	0.00	100.00	0.00
Duplek	0.00	0.00	100.00	0.00
Gorišnica	0.00	0.00	100.00	0.00
Gornja Radgona	0.00	0.00	100.00	0.00
Hrastnik	0.00	0.00	100.00	0.00
Hrpelje-Kozina	0.00	0.00	100.00	0.00
Ivančna Gorica	0.00	0.00	100.00	0.00
Izola/Isola	0.00	0.00	100.00	0.00
Juršinci	0.00	0.00	100.00	0.00
Kidričevo	0.00	0.00	100.00	0.00
Kočevo	0.00	0.00	100.00	0.00
Komen	0.00	0.00	100.00	0.00
Kungota	0.00	0.00	100.00	0.00
Lenart	0.00	0.00	100.00	0.00
Lendava/Lendva	0.00	0.00	100.00	0.00
Ljubno	0.00	0.00	100.00	0.00
Ljutomer	0.00	0.00	100.00	0.00
Logatec	0.00	0.00	100.00	0.00
Loški Potok	0.00	0.00	100.00	0.00
Luče	0.00	0.00	100.00	0.00
Majšperk	0.00	0.00	100.00	0.00
Mežica	0.00	0.00	100.00	0.00
Miren-Kostanjevica	0.00	0.00	100.00	0.00
Mislinja	0.00	0.00	100.00	0.00
Mozirje	0.00	0.00	100.00	0.00
Odranci	0.00	0.00	100.00	0.00
Ormož	0.00	0.00	100.00	0.00
Oslonica	0.00	0.00	100.00	0.00
Pesnica	0.00	0.00	100.00	0.00
Piran/Pirano	0.00	0.00	100.00	0.00
Pivka	0.00	0.00	100.00	0.00
Postojna	0.00	0.00	100.00	0.00
Rače-Fram	0.00	0.00	100.00	0.00
Radeče	0.00	0.00	100.00	0.00
Radenci	0.00	0.00	100.00	0.00
Ravne-Prevalje	0.00	0.00	100.00	0.00
Ribnica	0.00	0.00	100.00	0.00
Rogaška Slatina	0.00	0.00	100.00	0.00
Rogatec	0.00	0.00	100.00	0.00
Ruše	0.00	0.00	100.00	0.00
Sevnica	0.00	0.00	100.00	0.00
Sežana	0.00	0.00	100.00	0.00
Slovenska Bistrica	0.00	0.00	100.00	0.00
Starše	0.00	0.00	100.00	0.00
Sveti Jurij	0.00	0.00	100.00	0.00
Šentilj	0.00	0.00	100.00	0.00
Šentjernej	0.00	0.00	100.00	0.00
Škocjan	0.00	0.00	100.00	0.00
Šmartno ob Paki	0.00	0.00	100.00	0.00
Šoštanj	0.00	0.00	100.00	0.00
Trbovlje	0.00	0.00	100.00	0.00
Trebnje	0.00	0.00	100.00	0.00
Trzin	0.00	0.00	100.00	0.00
Turnišče	0.00	0.00	100.00	0.00
Videm	0.00	0.00	100.00	0.00
Vipava	0.00	0.00	100.00	0.00

Municipality	9° MCS	8° MCS	7° MCS	6° MCS
Vitanje	0.00	0.00	100.00	0.00
Zavrč	0.00	0.00	100.00	0.00
Zreče	0.00	0.00	100.00	0.00
Koper/Capodistria	0.00	0.00	100.00	0.00
Maribor	0.00	0.00	100.00	0.00
Murska Sobota	0.00	0.00	100.00	0.00
Nova Gorica	0.00	0.00	100.00	0.00
Ptuj	0.00	0.00	100.00	0.00
Slovenj Gradec	0.00	0.00	100.00	0.00
Velenje	0.00	0.00	100.00	0.00
Podvelka-Ribnica	0.00	0.00	94.50	5.50
Radlje ob Dravi	0.00	0.00	76.03	23.97
Puconci	0.00	0.00	72.38	27.62
Moravske Toplice	0.00	0.00	60.77	39.23
Dravograd	0.00	0.00	40.33	59.67
Rogaševci	0.00	0.00	36.37	63.63
Kuzma	0.00	0.00	6.30	93.70
Muta	0.00	0.00	4.07	95.93
Gornji Petrovci	0.00	0.00	0.00	100.00
Hodoš-Šalovci	0.00	0.00	0.00	100.00
Kobilje	0.00	0.00	0.00	100.00
Vuzenica	0.00	0.00	0.00	100.00
Slovenija	0.54	32.56	65.34	1.56

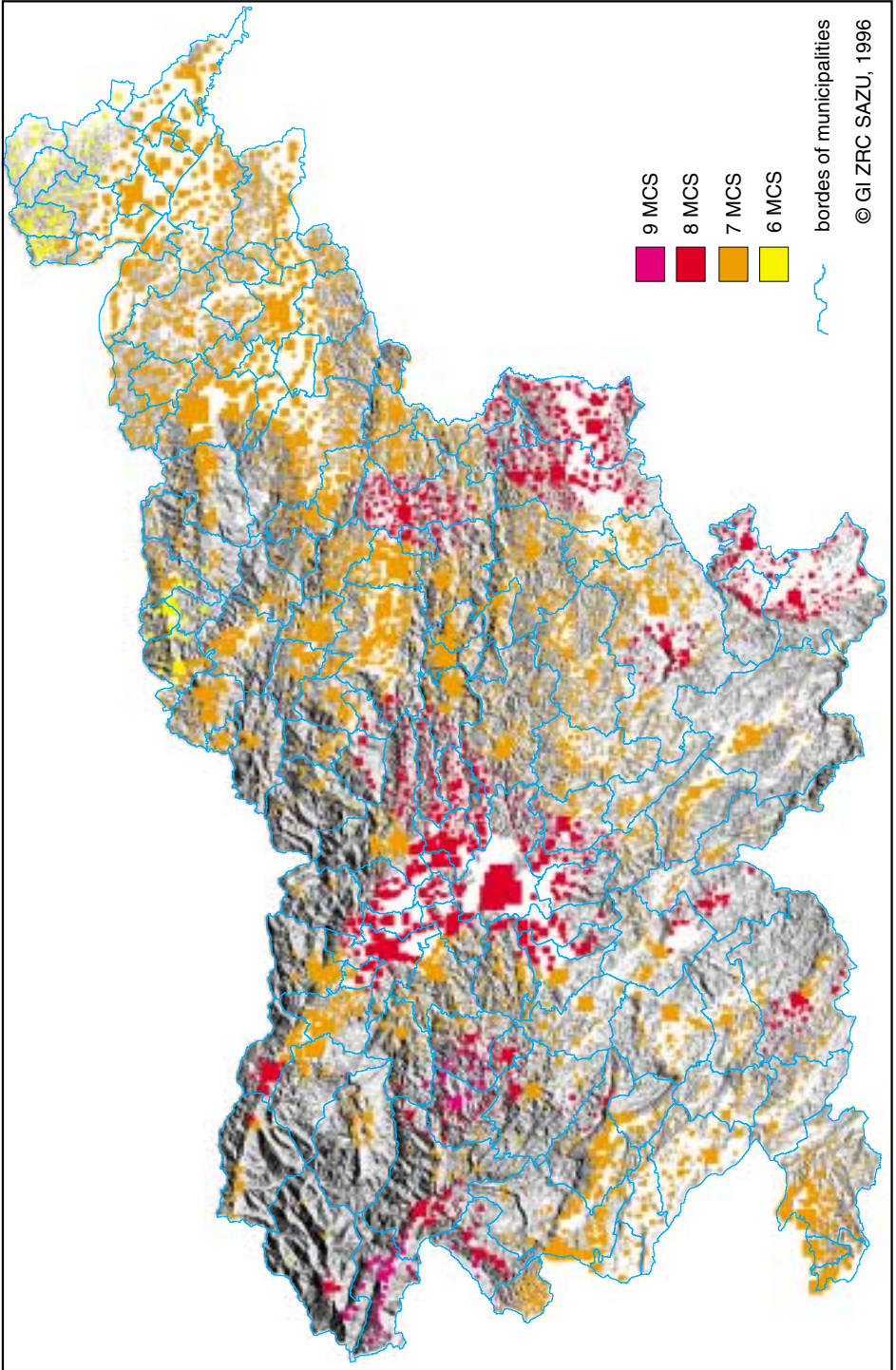
TABLE 6: COEFFICIENT OF EARTHQUAKE THREAT TO MUNICIPALITIES ACCORDING TO POPULATION.  
 PREGLEDNICA 6: KOEFICIENT POTRESNE OGROŽENOSTI OBČIN GLEDE NA PREBIVALSTVO.

Rank	Municipality	Coefficient	Rank	Municipality	Coefficient
1	Kobarid	1.0000	27	Šentjur pri Celju	0.6197
2	Cerkno	0.8289	28	Tolmin	0.6167
3	Kanal	0.6853	29	Jesenice	0.6009
4	Bovec	0.6810	30	Gorenja vas-Poljane	0.5976
5	Borovnica	0.6667	31	Naklo	0.5888
6	Brezovica	0.6667	32	Grosuplje	0.5886
7	Brežice	0.6667	33	Preddvor	0.5769
8	DoI pri Ljubljani	0.6667	34	Loška dolina	0.5687
9	Domžale	0.6667	35	Ilirska Bistrica	0.5323
10	Ig	0.6667	36	Kozje	0.5008
11	Lukovica	0.6667	37	Kamnik	0.4640
12	Mengeš	0.6667	38	Podčetrtek	0.4566
13	Metlika	0.6667	39	Štore	0.4538
14	Moravče	0.6667	40	Dobrova-Horjul-Polhov Gradec	0.4440
15	Šenčur	0.6667	41	Vrhnika	0.4431
16	Škofljica	0.6667		<b>Slovenija</b>	<b>0.4403</b>
17	Vodice	0.6667	42	Idrija	0.4226
18	Žiri	0.6667	43	Nazarje	0.4188
19	Ljubljana	0.6665	44	Šmarje pri Jelšah	0.3904
20	Cerklje na Gorenjskem	0.6566	45	Cerknica	0.3874
21	Kranj	0.6552	46	Novo mesto	0.3863
22	Črnomelj	0.6456	47	Litija	0.3823
23	Semič	0.6291	48	Velike Lašče	0.3799
24	Krško	0.6274	49	Železniki	0.3741
25	Medvode	0.6241	50	Kranjska Gora	0.3711
26	Gornji Grad	0.6235	51	Laško	0.3694

Rank	Municipality	Coefficient	Rank	Municipality	Coefficient
52	Zagorje ob Savi	0.3632	99	Piran/Pirano	0.3333
53	Ajdovščina	0.3529	100	Pivka	0.3333
54	Brda	0.3490	101	Postojna	0.3333
55	Žalec	0.3472	102	Rače-Fram	0.3333
56	Slovenske Konjice	0.3394	103	Radeče	0.3333
57	Škofja Loka	0.3371	104	Radenci	0.3333
58	Radovljica	0.3353	105	Ravne-Prevalje	0.3333
59	Bled	0.3343	106	Ribnica	0.3333
60	Celje	0.3342	107	Rogaška Slatina	0.3333
61	Vojnik	0.3339	108	Rogatec	0.3333
62	Beltinci	0.3333	109	Ruše	0.3333
63	Bohinj	0.3333	110	Sevnica	0.3333
64	Cankova-Tišina	0.3333	111	Sežana	0.3333
65	Črna na Koroškem	0.3333	112	Slovenska Bistrica	0.3333
66	Črenšovci	0.3333	113	Starše	0.3333
67	Destrišek-Trnovska vas	0.3333	114	Sveti Jurij	0.3333
68	Divača	0.3333	115	Šentilj	0.3333
69	Dobrepolje	0.3333	116	Šentjernej	0.3333
70	Dornava	0.3333	117	Škocjan	0.3333
71	Duplek	0.3333	118	Šmartno ob Paki	0.3333
72	Gorišnica	0.3333	119	Šoštanj	0.3333
73	Gornja Radgona	0.3333	120	Trbovlje	0.3333
74	Hrastnik	0.3333	121	Trebnje	0.3333
75	Hrpelje-Kozina	0.3333	122	Tržič	0.3333
76	Ivančna Gorica	0.3333	123	Turnišče	0.3333
77	Izola/Isola	0.3333	124	Videm	0.3333
78	Juršinci	0.3333	125	Vipava	0.3333
79	Kidričevo	0.3333	126	Vitanje	0.3333
80	Kočevje	0.3333	127	Zavrč	0.3333
81	Komen	0.3333	128	Zreče	0.3333
82	Kungota	0.3333	129	Koper/Capodistria	0.3333
83	Lenart	0.3333	130	Maribor	0.3333
84	Lendava/Lendva	0.3333	131	Murska Sobota	0.3333
85	Ljubno	0.3333	132	Nova Gorica	0.3333
86	Ljutomer	0.3333	133	Ptuj	0.3333
87	Logatec	0.3333	134	Slovenj Gradec	0.3333
88	Loški Potok	0.3333	135	Velenje	0.3333
89	Luče	0.3333	136	Podvelka-Ribnica	0.3150
90	Majšperk	0.3333	137	Radlje ob Dravi	0.2534
91	Mežica	0.3333	138	Puconci	0.2413
92	Miren-Kostanjevica	0.3333	139	Moravske Toplice	0.2026
93	Mislinja	0.3333	140	Dravograd	0.1344
94	Mozirje	0.3333	141	Rogaševci	0.1212
95	Odranci	0.3333	142	Kuzma	0.0210
96	Ormož	0.3333	143	Muta	0.0136
97	Osilnica	0.3333	144	Gornji Petrovci	0.0000
98	Pesnica	0.3333	145	Hodoš-Šalovci	0.0000
			146	Kobilje	0.0000
			147	Vuzenica	0.0000

## 4. Assessment of Earthquake Threat by settlements

Using the Geographical Information System we combined the layer of seismic zones with the layer of centroids (coordinates) of settlements (Republiška ... 1991) and for every settlement in Slovenia first determined partial assessments of earthquake threat relative to the population, relative to the



threat to the active population, that is, the number of work places, and relative to the age of housing. Then we calculated the mean assessment of earthquake threat to settlements relative to population and age of housing (Popisi ... 1961, 1991).

The source of data on the number and age of housing is the 1991 census of population and housing which offers two synthetic indicators.

The first shows the proportion (%) of individual types of housing in a settlement, informing us of the structural characteristics of individual settlements. It is significant whether we are dealing with a majority of individual and more or less scattered houses or with multistory buildings in which the concentration of population is substantially higher and therefore offers the possibility of a much larger number of victims. While naturally we must not generalize this information uncritically, according to experience, however, the difference in the concentration of population between individual housing and apartment buildings is approximately in the ratio of one to three.

The second synthetic indicator shows the dominant age of the housing in individual settlements (Ravbar 1995). The following six types of settlements in Slovenia relative to the dominant age of housing are shown with letters on figure 10:

- A** distinct domination of housing built before 1945 (above 50%),
- B** distinct domination of housing built between 1945 and 1970 (above 50%),
- C** distinct domination of housing built after 1970 (above 50%),
- a** moderate domination of housing built before 1945,
- b** moderate domination of housing built between 1945 and 1970,
- c** moderate domination of housing built after 1970.

“Distinct domination” means that more than 50% of all the housing was built in a certain period (absolute domination), while “moderate domination” means that while less than half of the housing was built in a certain period it is more than in either of the other two periods (relative dominance). It generally applies that the older the housing is, the worse its quality and the lower the safety of its anti-earthquake technical construction. The greater the proportion of new housing in the settlement is, particularly that built after 1970 when earthquake proof construction received more attention, the less the threat to the settlement.

According to the dominant age of their housing, settlements may be divided into three basic types:

- settlements with absolute and relative domination of housing built after 1970,
- settlements with absolute and relative domination of housing built between 1945 and 1970,
- settlements with absolute and relative domination of housing built before 1945.

Here we are assuming that the settlements more threatened by earthquake are those which are dominated by older housing and vice versa (Tomažević 1987). Modern anti-earthquake construction came into use to a greater extent following the 1963 Skopje earthquake (Tomažević, Sheppard 1982). We divided the fifty-year period following World War II into two equal twenty-five year periods. Simplified, the first period is that before the increasing use of anti-earthquake construction, while the second is the modern period. Of course, we also considered older buildings as well, which we combined as housing built before the end of World War II.

On the other hand, we combined settlements according to their location in seismic zones into four basic types:

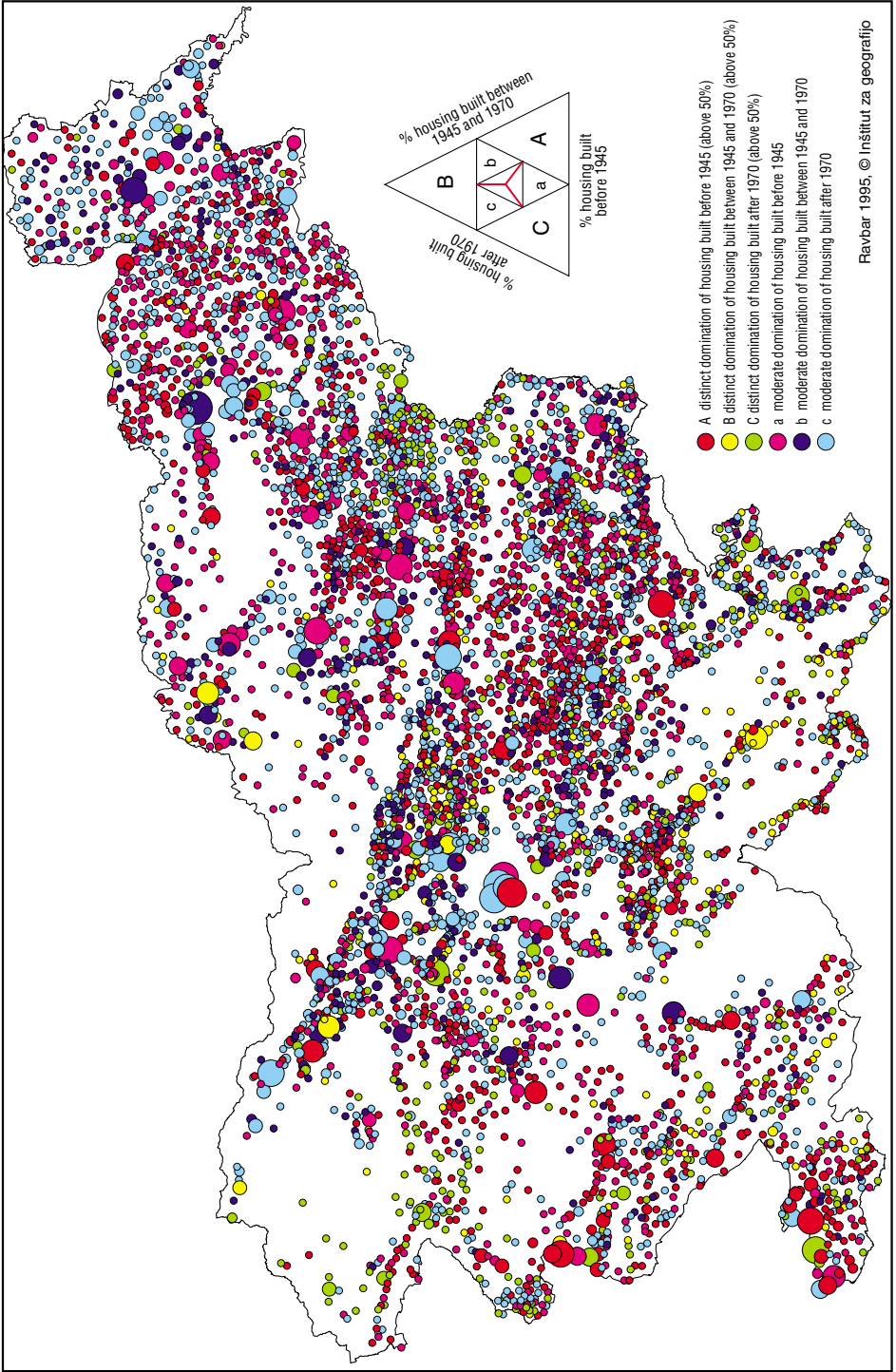
- settlements located in 6° MCS zones,
- settlements located in the 7° MCS zone,
- settlements located in 8° MCS zones,
- settlements located in 9° MCS zones.

For every settlement we combined the types relative to age of housing and to location in seismic zones and got twelve combinations or categories that we sorted from lowest to highest earthquake threat as follows:

- category 1 in 6° MCS zones dominated by housing built after 1970,
- category 2 in 6° MCS zones dominated by housing built between 1945 and 1970,

Figure 9: Highest expected degree MCS by settlements for the 500 year return period (M 1 : 1,300,000).

Slika 9: Največja pričakovana MCS stopnja po naseljih za 500 letno povratno periodo (M 1 : 1,300,000).



- category 3 in 6° MCS zones dominated by housing built before 1945,
- category 4 in 7° MCS zone dominated by housing built after 1970,
- category 5 in 7° MCS zone dominated by housing built between 1945 and 1970,
- category 6 in 7° MCS zone dominated by housing built before 1945,
- category 7 in 8° MCS zones dominated by housing built after 1970,
- category 8 in 8° MCS zones dominated by housing built between 1945 and 1970,
- category 9 in 8° MCS zones dominated by housing built before 1945,
- category 10 in 9° MCS zones dominated by housing built after 1970,
- category 11 in 9° MCS zones dominated by housing built between 1945 and 1970,
- category 12 in 9° MCS zones dominated by housing built before 1945.

This means that the MCS degree is considered in first place and within this, the age of the housing.

TABLE 7: SURVEY OF THE NUMBER AND PROPORTION OF SETTLEMENTS AND NUMBER AND PROPORTION OF POPULATION BY DEGREE OF EARTHQUAKE THREAT TO SETTLEMENTS.

PREGLEDNICA 7: PREGLED ŠTEVILA IN DELEŽA NASELJIJ TER ŠTEVILA IN DELEŽA PREBIVALCEV PO STOPNJIH POTRESNE OGROŽENOSTI NASELJIJ.

Synthetic type	Number of settlements	Proportions of number of settlements in %	Population in 1991	Proportion of population in 1991 in %
12	41	0.69	6883	0.35
11	4	0.07	142	0.01
10	22	0.37	3548	0.18
9	556	9.40	166360	8.46
8	285	4.82	101894	5.18
7	664	11.22	371923	18.92
6	1984	33.52	622551	31.66
5	679	11.47	291325	14.82
4	1589	26.85	370958	18.87
3	33	0.56	13334	0.68
2	22	0.37	6679	0.34
1	39	0.66	10609	0.54
Total	5918	100.00	1965983	100.00

The number of settlements is relatively normally distributed according to the degree of earthquake threat, and in even larger measure this also applies to the distribution of the population of the settlements.

In Slovenia there are forty-one settlements in the 12th degree earthquake threat category in which 6,883 people lived in 1991, that is, barely one third of the total population of Slovenia lives in settlements in 9° MCS zones in housing built mostly before 1945.

It is similar at the other extreme since there are only thirty-nine settlements in the 1st degree earthquake threat category in which 10,609 people lived in 1991. This means that only 0.5% of the total population of Slovenia lived in settlements in 6° MCS zones in housing built mostly after 1970.

The greatest number of settlements are in the 6th category, that is, in the 7° MCS zone dominated by housing built before 1945. In these settlements, a third of all Slovene settlements, 622,551 people lived in 1991, that is, almost one third of the total population of Slovenia in that year.

The number of settlements stands out in the 4th category where the settlements are located in the 7° MCS zone with housing built mainly after 1970. In these settlements, which represent more than 25% of all settlements in Slovenia, 370,958 people lived during the 1991 census, a little less than one fifth of the total population of Slovenia.

Figure 10: Pattern of settlements and age of housing by settlement in Slovenia (M 1 : 1,300,000; Ravbar 1995, cartography Sajko Institute for Geography).

Slika 10: Starost stanovanjskih objektov po naseljih v Republiki Sloveniji (M 1 : 1,300,000; Ravbar 1995, kartografija Sajko Inštitut za Geografijo).



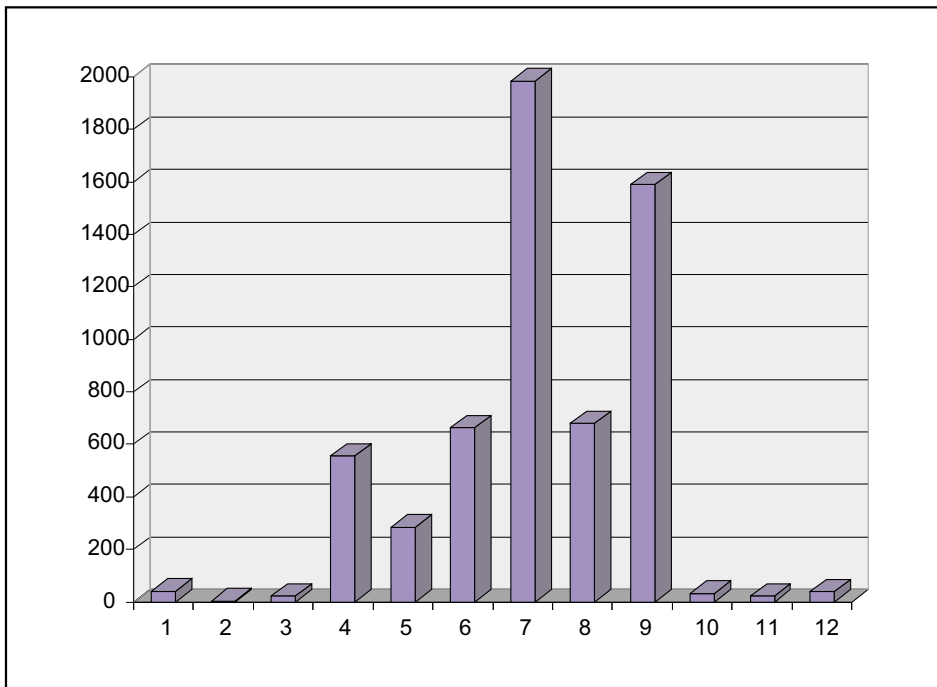


Figure 11: Number of settlements by degree of earthquake threat to settlements.  
 Slika 11: Število naselij po stopnjah potresne ogroženosti naselij.

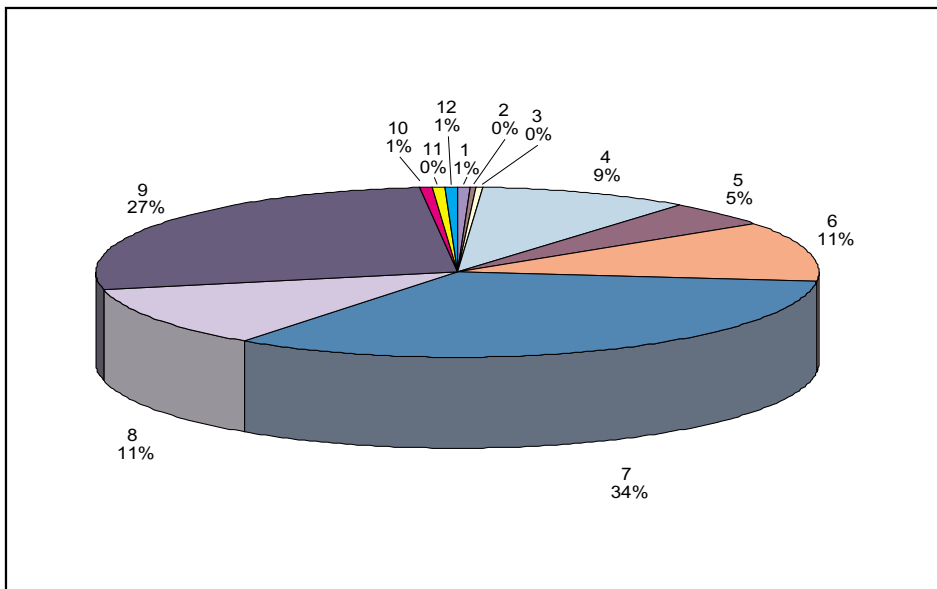


Figure 12: Proportion of population of Slovenia in 1991 by degree of earthquake threat to settlements.  
 Slika 12: Deleži števila prebivalcev Slovenije leta 1991 po stopnjah potresne ogroženosti naselij.

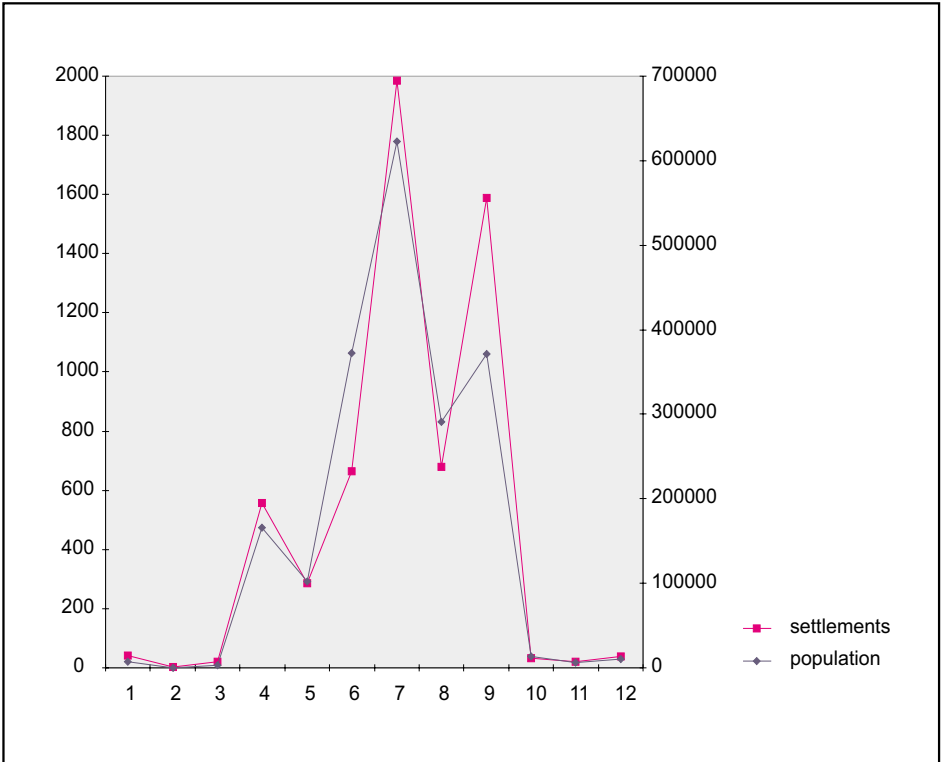


Figure 13: Comparison of number of settlements and population by degree of earthquake threat to settlements in Slovenia in 1991. Slika 13: Primerjava števila naselij in števila prebivalcev po stopnjah potresne ogroženosti naselij v Sloveniji leta 1991.

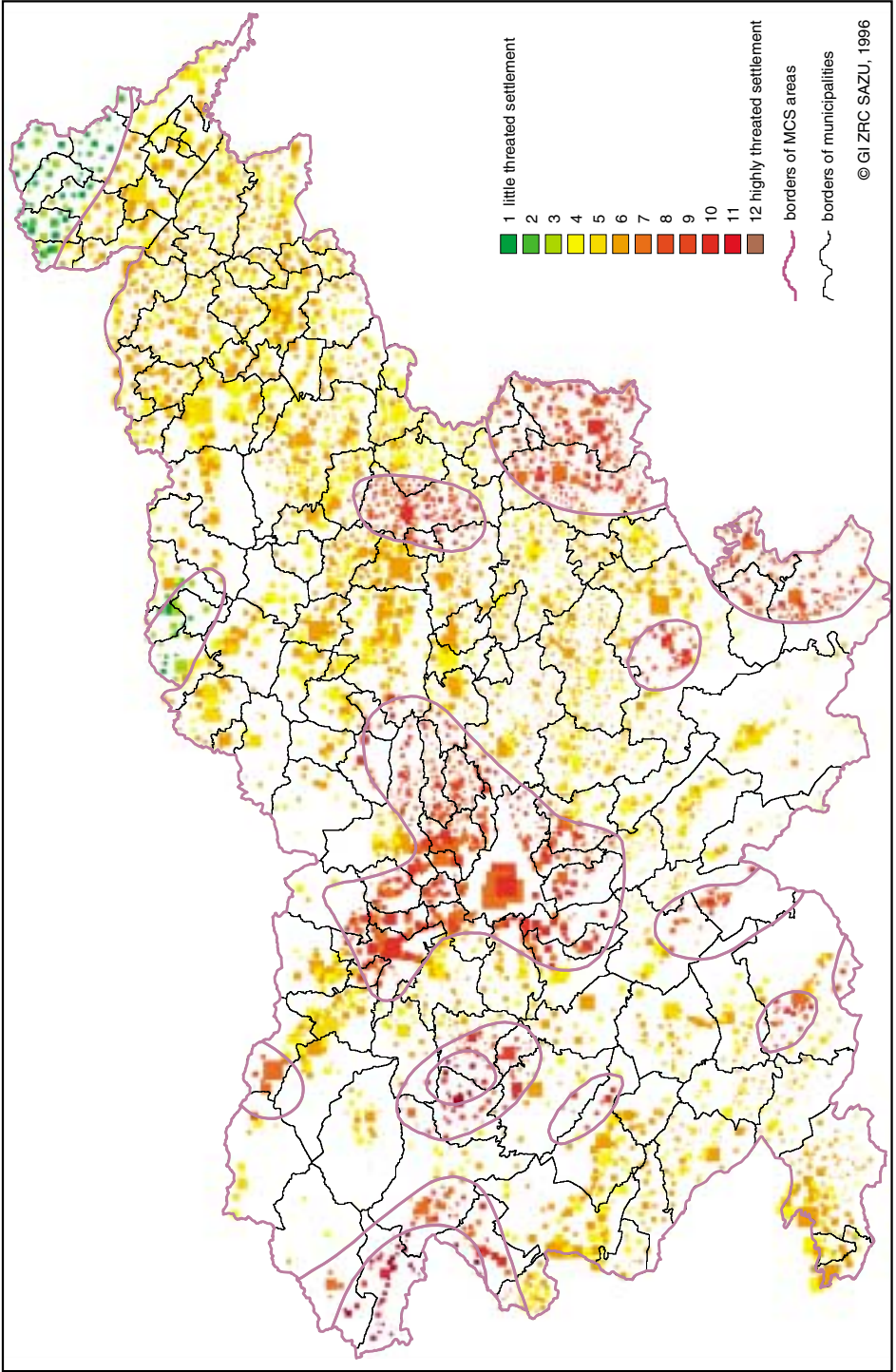
The largest average size of settlements is found in the 7th category, some 560 people, where the settlements are in 8° MCS zones dominated by housing built after 1970. It is followed by the 5th category, 429 people per settlement, where the settlements are in the 7° MCS zone dominated by housing built between 1945 and 1970.

Only in the 11th and 12th categories is the average size of settlements less than 200 people. This means that the smallest settlements are in the most threatened categories, which is understandable since these are settlements with falling populations, badly aging structure, and old housing.

## 5. Conclusion

On one hand, our work was oriented toward research of relatively great detail, examining and determining the earthquake threat for every Slovene settlement and each Slovene municipality; on the other hand, we were also interested in the overall earthquake threat to the whole of Slovenia.

According to the 1987 seismic map for 500 year return periods, Slovenia has less than two percent of its surface area in the 9° MCS earthquake zone. At the same time, this is a sparsely settled area since in 1991 only 0.5% of the population of Slovenia lived here and the density of population was barely twenty-nine people per square kilometer while the Slovene average in the same period was ninety-seven people per square kilometer. The number of the active population or of work places here was 4,557, some 0.5% of all work places in Slovenia. These are areas of strong depopulation trends, a factor quite distinct in the 9° MCS Upper Soča Earthquake Zone (9 a), and somewhat less distinct



in the 9° MCS Idrija Earthquake Zone (9b). From the point of view of earthquake threat this is gratifying, but we must be aware, however, that there are still more than 10,000 people living in these areas.

There are twelve 8° MCS zones that together embrace a good fifth of Slovenia (21.27%), a third of its population (32.56%), and one third of its work places (33.78%). Together with the 9° MCS zones they cover 23.26% of the surface of Slovenia, almost one quarter of the country. In these zones major consequences from earthquakes and more human casualties can be expected. In total somewhat over 650,000 people live in these zones, mostly in the 8° MCS zones where the average density of population is 148 people per square kilometer, in some individual zones almost 300 people per square kilometer (8g), and where there are almost 340,000 active working people. Overall, the 8° MCS zones are areas of population growth; between 1961 and 1991 their populations grew by one third, although in individual zones the population has dropped (8č, 8e, 8f). If we study the 8° MCS zones in more detail, this situation appears primarily due to the intense growth of population in zone 8g, that is, in the Ljubljana Basin. Numerous functions vital to the Slovene state are situated in this zone, which further increases the level of danger. All this supports the strategic correctness of the systematic orientation toward the polycentric development of the Republic of Slovenia that should mitigate the effects on the central functions of the state in the event of a catastrophic earthquake in zone 8g. If this zone were struck by an earthquake equal to that of 1895, the consequences would be substantially greater. One hundred years ago, Ljubljana was a provincial city with less than 30,000 residents, while today with its suburbs and as the capital of the country it has more than 300,000 residents. Earthquake zone 8g alone contains one quarter of the work places in Slovenia.

The 7° MCS earthquake zone covers three quarters of the surface of Slovenia. In 1991, two thirds of the population of Slovenia lived here, and the population density was eighty-six people per square kilometer, below the Slovene average. Here also were two thirds of all Slovene work places. Between 1961 and 1991 the population here increased by one fifth.

In Slovenia we have only two 6° MCS zones which together cover a little less than three percent of the country's surface area in which only a little over 1.5% of the population lives and where a little less than 1.5% of the population works. These are the only relatively earthquake safe zones in Slovenia. The National Geophysics Administration of the Republic of Slovenia is preparing a new and enhanced seismic map of Slovenia. The work has not yet been completed and, which is just as important, is therefore not yet part of the technical building regulations. When this map is completed and officially adopted as the starting point for applying technical construction measures, it will be sensible to further suitably elaborate this research.

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Figure 14: Degree of earthquake threat to settlements in Slovenia (M 1 : 1,300,000).  
Slika 14: Stopnja potresne ogroženosti naselij v Sloveniji (M 1 : 1,300,000).

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## 7. Povzetek – Summary

### Potresna ogroženost občin in naselij v Sloveniji

Milan Orožen Adamič  
Drago Perko

Naše delo je bilo na eni strani usmerjeno v raziskovanje razmeroma velikih podrobnosti, raziskovanje in ugotavljanje potresne ogroženosti vsakega slovenskega naselja in vsake slovenske občine, na drugi strani pa nas je zanimala tudi celovita potresno ogroženost Slovenije.

Po seizmični karti iz leta 1987 za petstoletno povratno periodo je v Sloveniji manj kot 2 % površine v 9. MCS območju. Hkrati je to redko poseljeno območje, saj je v njem leta 1991 prebivalo le pol odstotka prebivalcev Slovenije, gostota prebivalstva pa je bila komaj 29 ljudi na km<sup>2</sup>, slovensko povprečje pa je bilo istega leta 97 ljudi na km<sup>2</sup>. Število aktivnih prebivalcev oziroma delovnih mest je bilo 4557, kar je pol odstotka vseh delovnih mest v Sloveniji. To so območja močne depopulacije, ki je bolj izrazita v Zgornjesoškem območju 9. MCS stopnje (9 a) in nekoliko manj izrazita v Idrijskem območju 9. MCS stopnje (9 b). To je z vidika potresne ogroženosti sicer razveseljivo, vendar se moramo zavedati, da na teh območjih še vedno živi več kot 10.000 ljudi.

Območje 8. MCS stopnje je 12 in skupaj obsegajo dobro petino Slovenije (21,27 %), tretjino prebivalstva Slovenije (32,56 %) in tretjino delovnih mest (33,78 %). To je skupaj z območji 9. MCS stopnje 23,26 % površine Slovenije, kar je slaba četrtina Slovenije. V teh območjih pričakujemo večje posledice potresov in tudi človeške žrtve. V celoti v teh krajih prebiva nekaj čez 650.000 prebivalcev, večina na območjih 8. MCS stopnje, kjer je povprečna gostota prebivalstva 148 ljudi na km<sup>2</sup>, na po-

sameznih območjih pa skoraj 300 (8 g), dela pa skoraj 340.000 ljudi. V celoti so območja 8. MCS stopnje območja naraščanja števila prebivalcev, med letoma 1961 in 1991 je naraslo kar za tretjino, na posameznih območjih pa število prebivalcev tudi upada (8 č, 8 e, 8 f). Če nekoliko podrobneje pogledamo območja 8. MCS stopnje, je taka situacija predvsem zaradi intenzivne rasti prebivalstva v območju 8 g oziroma v Ljubljanski kotlini. Tu so koncentrirane številne vitalne funkcije slovenske države, kar še povečuje stopnjo nevarnosti. Vse to potrjuje strateško pravilnost sistematičnega usmerjanja v policentričen razvoj Republike Slovenije in s tem zmanjševanje prizadetosti centralnih funkcij države ob katastrofalnem potresu v območju 8 g. Če bi območje prizadel enak potres kot leta 1895, bi bile posledice bistveno večje. Pred 100 leti je bila Ljubljana provincialno mesto z manj kot 30.000 prebivalci, danes pa ima z obrobjem kot prestolnica države več kot 300.000. Samo območje 8 g ima kar četrtno delovnih mest v Sloveniji.

Območje 7. MCS stopnje obsega tri četrtine površine Slovenije. Tu sta leta 1991 prebivali dve tretjini prebivalstva Slovenije, gostota pa je bila 86 ljudi na km<sup>2</sup>, torej pod slovenskim povprečjem, tu pa je bilo tudi dve tretjini vseh slovenskih delovnih mest. Število prebivalcev se je med letoma 1961 in 1991 povečalo za petino.

V Sloveniji imamo le dve območji 6. MCS stopnje, ki skupaj obsegata slabe 3 % njene površine, v njih prebiva le dober odstotek in pol prebivalstva Slovenije, dela pa slab odstotek in pol. To so edina pred potresi razmeroma varna območja Slovenije.

Uprava za geofiziko Republike Slovenije pripravlja novo izpopolnjeno seizmično karto Slovenije, ki pa še ni končana in, kar je prav tako pomembno, zato tudi ni del gradbenotehnične regulative. Ko bo ta karta izdelana in tudi uradno sprejeta kot izhodišče za uveljavljanje gradbenotehničnih ukrepov, bo smiselno to raziskavo ustrezno dopolniti.