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Seismicity of Croatia in the period 2006–2015

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During the ten-year period from 2006 to 2015 a total of 36 733 earthquakes were located in Croatia and its surrounding areas, with 37 main events registering magnitudes from 4.0 to 4.9. Seismically the most active was the coastal part of Croatia confined to two seismically distinguished areas. The NW domain was seismically less active, with almost 10 000 located events (seven were of magnitude $M_L \geq 4.0$), among which were the three strongest events that occurred in Croatia during the observed period. Two of them occurred in the Senj epicentral area, the first one on 5 February 2007 at 8:30 UTC ($M_L = 4.9$, I_{max} = VII °MSK) and the second one on 30 July 2013 at 12:58 UTC, ($M_L = 4.8$, I_{max} = VI °MSK). The third event occurred near Kornati Islands on 18 July 2007 at 10:54 UTC ($M_L = 4.8$). The SE domain experienced the highest number of earthquakes (over 19 000 located events, with 24 events of magnitude $M_L \geq 4.0$, among which the strongest one was of magnitude $M_L = 4.9$ with the epicentre in Bosnia and Herzegovina near the Croatian border). The seismicity in the continental part of Croatia was weak-to-moderate, with earthquakes of magnitudes $M_L \leq 4.1$. Focal mechanisms were obtained for 31 earthquakes with magnitudes $M_L \geq 4.0$, and individual earthquakes have also been macroseismically analysed. Low current moment release rates for both regions (continental and coastal) as compared to long-term averages, indicate the regions are currently in the strain accumulation phase.

Keywords: seismicity, Croatia, fault-plane solutions, earthquake catalogue, macroseismic maps

1. Introduction

The present paper summarises seismic activity on the territory of Croatia and the surrounding regions in the period 2006–2015. It is a follow-up on a series of publications (Markušić et al., 1990, 1993, 1998; Ivančić et al., 2002, 2006) presenting overviews of Croatian seismicity from 1988 until 2005. The first compilation of the Croatian Earthquake Catalogue (CEC) was initiated as a part of the UNDP/UNESCO project Survey of the Seismicity of the Balkan Region (Shebalin et al., 1974). The part of the catalogue covering Croatia and its neighbouring regions constituted the core of the Croatian catalogue that was continually amended and supplemented with new data. CEC acquired its latest format with its revised release for the 1908–1992 period (Herak et al., 1996). The catalogue is being supplemented ever since on the yearly basis, and its latest version is stored in the archives of the Department of Geophysics of the Faculty of Science, University of Zagreb.

Croatia belongs to the seismotectonic area shaped by the thrusting of the Adriatic microplate (Adria) under the European lithosphere in the convergent boundary zone between the African and the Eurasian plates. The collision between Adria and Eurasia being rather complex, its (seismo)tectonic implications still remain not completely understood and are the subject of ongoing research (*e.g.* Ustaszewski et al., 2008, 2010; Subašić et al., 2017). Adria has been, until recently, assumed to be a single rigid block rotating counter-clockwise around the pole in northern Italy (*e.g.* Anderson & Jackson 1987; Calais et al. 2002). According to recent seismic data and Global Positioning System velocities, Adria is today generally considered to consist of two or even three smaller units (Oldow et al. 2002; Herak et al. 2005; Ivančić et al. 2006). The Dinarides, extending from the Southern Alps in the northwest to the Albanides and the Helenides in the southeast, are an active fold-and-thrust belt that resulted from the collision of the Adriatic and European plates and the subsequent propagation of the deformation front towards the Adriatic Sea. They are further subdivided into the External and the Internal Dinarides (*e.g.* Tomljenović et al., 2008; Handy et al., 2015; Tari and Pamić, 1998). At present, the area is subject to SSW–NNE to SSE–NNW compression which causes the characteristic NW–SE fault strikes and southwesterly vergence of folded structures and represents the seismically most active region in Croatia (*e.g.* Tomljenović et al, 2008; Schmid et al., 2008; Ustaszewski et al., 2014, Herak et al., 2016).

2. Data and methods

In this paper we present compiled and processed data for all recorded earthquakes (2006–2015) in Croatia and its immediate vicinity (the area bounded by the red dashed line in Fig. 1(a)). All data were processed by the staff of the Croatian Seismological Survey and of the A. Mohorovičić Geophysical Institute (both at the Department of Geophysics, Faculty of Science, Zagreb). Fig. 1(a) shows the locations of all considered epicentres (regardless of magnitude), together with the lower hemisphere projection of fault-plane solutions for earthquakes with magnitudes $M_L \geq 4.0$, computed by analyses of the first-motion polarity readings on regional seismological stations as described in Herak et al. (2016). Special attention was paid to the earthquakes with magnitudes greater or equal to 4.0 (all mainshocks with magnitudes $M_L \geq 4.0$ recorded during the 2006–2015 period are listed in Tab. 1). Table 2 summarizes obtained focal mechanisms for 31 earthquakes with magnitudes $M_L \geq 4.0$ recorded in Croatia, listing main stress axes and fault plane parameters of both nodal planes. Individual earthquakes have also been macroseismically analysed.

In order to determine the earthquake parameters, data from the Croatian Seismological Network were supplemented by readings reported in monthly bul-

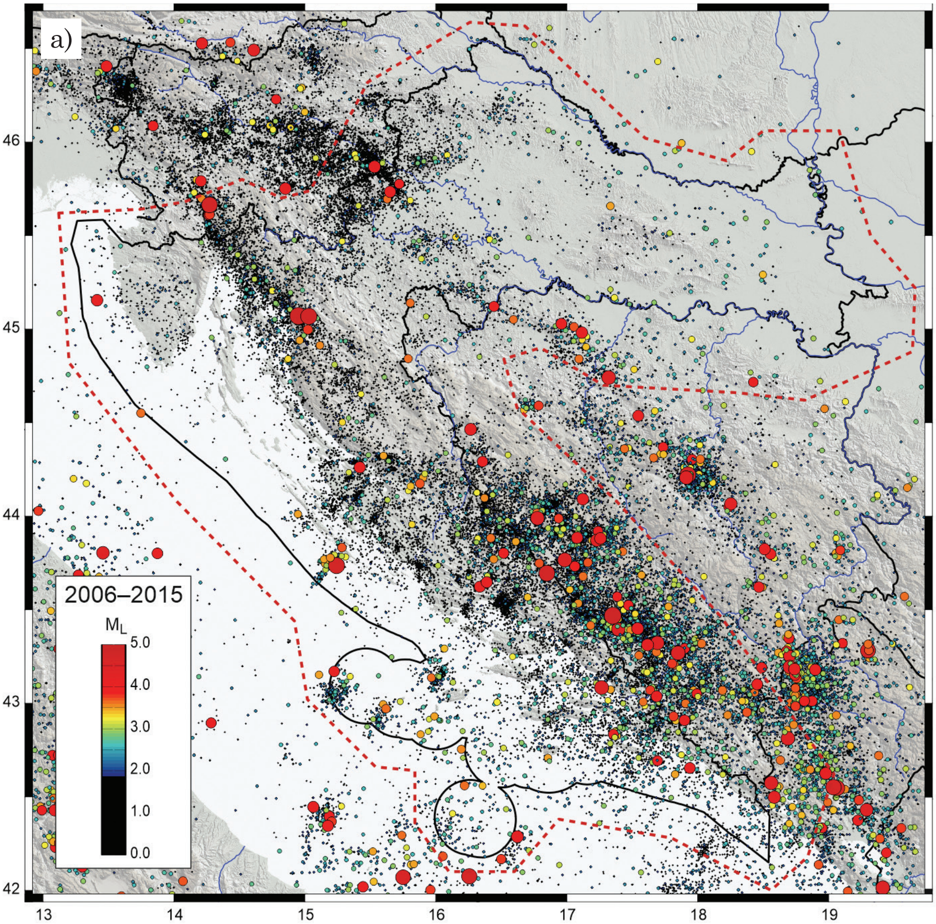

Figure 1. (*a*) Map of epicentres of earthquakes from the Croatian Earthquake Catalogue (2006–2015). The red dotted line shows the wider area around Croatia considered in this paper. (*b*) Fault-plane solutions for 31 earthquakes obtained in this study are shown (lower hemisphere projection, see text for more detail). The identification numbers refer to Tab. 2. Compressive quadrants are shaded. The most important sections of seismogenic faults are shown after Ivančić et al. (2006): A – Drava fault, B – Medvednica Fault, C – Sava fault, D – Ivančica Mt. and Kalnik-North fault, E – Ilirska Bistrica–Vinodol fault, F – Velebit fault, G – Krk fault, H – Pag fault, I – Drniš fault, J – Imotski fault, K – Mosor–Biokovo fault, L – Dubrovnik fault, M – Jabuka–Andrija fault, N – South Adriatic fault.

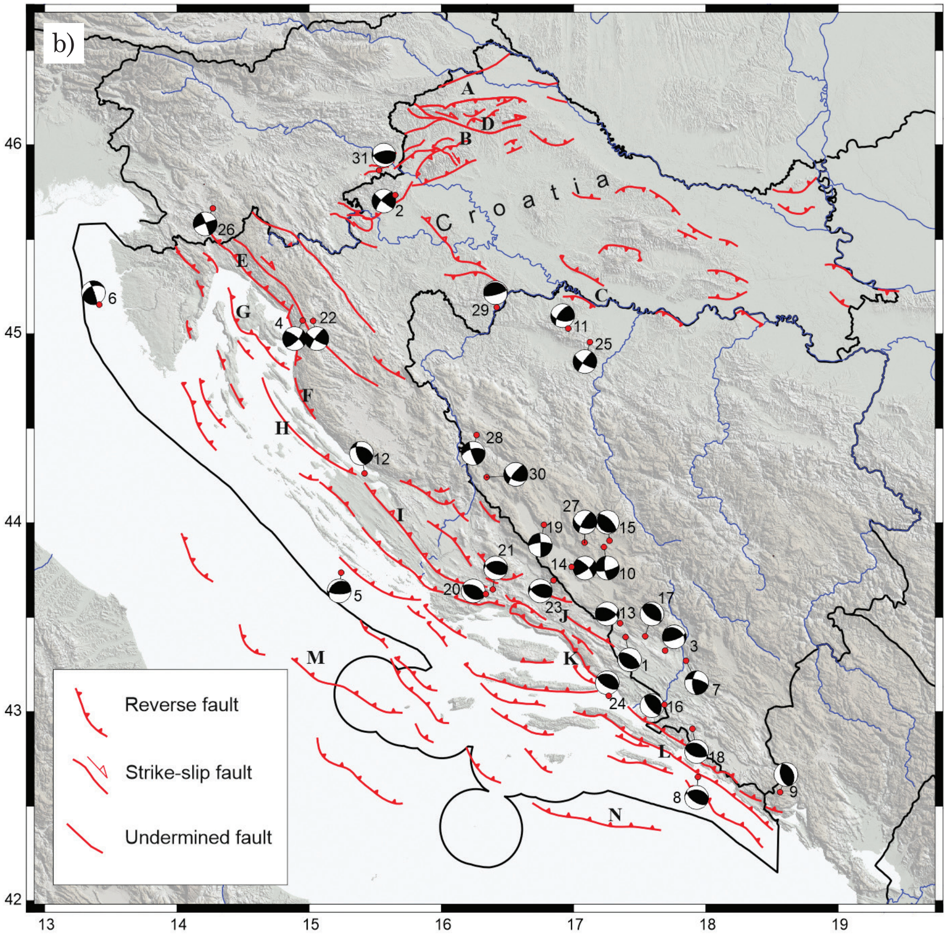

Figure 1. Continued.

letins of seismological stations in the neighbouring countries. The earthquake hypocentral coordinates and origin times were calculated by the latest version of the HYPOSEARCH program based on a grid-search algorithm (Herak, 1989) using both P- and S-wave arrival times, and the crustal model from B.C.I.S. (1972) that was modified by adding a thin layer on top. In addition to the information on where and when an earthquake took place (epicentre coordinates and epicentral time), its focal depth, magnitudes and epicentral intensity, the catalogue contains the data on the location reliability, number of data used and references for each entry.

Fault-plane solutions presented in this paper (Fig. 1(b)) were evaluated using data on the first motion polarity which were read from the original seismograms

Table 1. Hypocentral parameters for mainshocks with magnitude $M_L \geq 4.0$ in Croatia and the surrounding areas during the 2006–2015 period (earthquakes within Croatian borders are shown in bold).

Date	Origin Time (UTC)	Epicentre		Depth	M_L	I_{max}	FPS No. (Tab. 2.)
		φ (°N)	λ (°E)	(km)		(°MSK)	
28 Jan. 2006	19:26:04.2	43.395	17.393	5.3	4.4	VI–VII	1
28 Oct. 2006	**13:55:29.8**	**45.734**	**15.651**	**15**	**4.1**	**VI–VII**	**2**
03 Feb. 2007	10:49:12.8	43.323	17.692	19.8	4.4		3
05 Feb. 2007	**08:30:04.5**	**45.07**	**14.95**	**13.4**	**4.9**	**VII**	**4**
18 Jul. 2007	**10:54:11.2**	**43.736**	**15.242**	**2.7**	**4.8**		**5**
13 Aug. 2007	**13:58:28.6**	**45.154**	**13.413**	**18.3**	**4.1**		**6**
28 Sep. 2007	**06:59:22.9**	**43.17**	**15.224**	**6.7**	**4.0**		
18 Oct. 2007	15:41:21.2	43.269	17.85	10.2	4.5		7
18 Oct. 2007	18:15:17.2	43.312	17.617	7.6	4.2		
31 Mar. 2008	**00:14:34.9**	**42.654**	**17.94**	**10.1**	**4.0**	**V**	**8**
14 Nov. 2008	13:26:04.8	42.574	18.561	12.1	4.4		9
21 Dec. 2008	20:20:16.7	43.871	17.229	10.3	4.3		10
07 May 2009	12:11:05.9	45.028	16.959	7.8	4.1		11
21 Jun. 2009	**10:54:37.1**	**44.261**	**15.419**	**13.9**	**4.1**	**V–VI**	**12**
21 Jun. 2009	11:20:02.5	43.468	17.351	2.8	4.9	VI	13
04 Jun. 2010	**18:44:53.9**	**42.287**	**16.623**	**16.2**	**4.2**		**14**
20 Jun. 2010	23:13:51.6	43.766	16.985	11.8	4.5		
08 Feb. 2011	16:29:44.6	43.905	17.271	0.2	4.2		15
17 Jun. 2011	**05:31:04.5**	**43.802**	**16.517**	**6.3**	**4.0**		
15 Aug. 2011	13:08:34.4	43.037	17.686	14.4	4.1		16
20 Aug. 2011	09:07:46.3	43.399	17.541	3.5	4.2		17
25 Sep. 2011	13:17:09.6	42.498	18.585	10.3	4.3		
14 Dec. 2011	19:47:13.9	42.909	17.899	12.3	4.0		18
03 Aug. 2012	19:57:24.2	43.989	16.776	11.7	4.4		19
08 Oct. 2012	12:18:45.0	44.091	17.123	2.4	4.2		
17 Jan. 2013	**13:21:49.1**	**43.623**	**16.336**	**6.3**	**4.1**	**V–VI**	**20**
04 Feb. 2013	**04:29:45.4**	**43.647**	**16.389**	**3.5**	**4.1**	**V**	**21**
30 Jul. 2013	**12:58:30.0**	**45.068**	**15.03**	**18.3**	**4.8**	**VI**	**22**
18 Nov. 2013	**07:58:40.9**	**43.695**	**16.848**	**7.9**	**4.7**	**VI–VII**	**23**
29 Dec. 2013	**06:54:56.8**	**43.084**	**17.266**	**6.8**	**4.5**	**V**	**24**
28 Jan. 2014	00:03:31.2	44.981	17.115	6.2	4.1		25
22 Apr. 2014	08:58:27.5	45.664	14.272	17	4.7		26
19 Jun. 2014	13:52:16.3	43.901	17.083	0.1	4.1		27
30 Aug. 2014	18:16:45.0	44.464	16.266	11.7	4.2		28
02 Oct. 2014	04:43:34.8	45.121	16.444	15.7	4.0	V–VI	29
01 Apr. 2015	07:33:50.8	44.292	16.357	7.3	4.0		30
01 Nov. 2015	07:52:32.9	45.868	15.531	10.1	4.2		31

Table 2. Fault-plane solutions for 31 earthquakes that occurred in Croatia and surrounding areas in the period 2006 – 2015, with magnitudes $M_L \geq 4.0$.

No	Date	Origin Time (UTC)	P-axes		T-axes		Nodal plane 1 (Left lateral)			Nodal plane 2 (Right lateral)		
			Fault Plane Parameters									
			Azimuth	Dip	Azimuth	Dip	Strike	Dip	Rake	Strike	Dip	Rake
1	28 Jan. 2006	19:26:04.2	33	14	218	76	121	31	87	304	59	92
2	28 Oct. 2006	13:55:29.8	176	7	84	17	221	73	7	129	83	163
3	03 Feb. 2007	10:49:12.8	180	22	308	57	71	71	65	306	31	141
4	05 Feb. 2007	08:30:04.5	357	2	266	28	45	69	19	308	72	158
5	18 Jul. 2007	10:54:11.2	168	22	28	62	229	27	51	91	69	108
6	13 Aug. 2007	13:58:28.6	105	26	214	34	341	85	45	246	45	173
7	18 Oct. 2007	15:41:21.2	50	5	144	37	283	69	31	181	61	156
8	31 Mar. 2008	00:14:34.9	203	10	78	72	275	37	65	125	57	108
9	14 Nov. 2008	13:26:04.8	251	7	118	80	333	39	79	167	52	99
10	21 Dec. 2008	20:20:16.7	34	25	125	2	77	74	–19	173	71	–163
11	07 May 2009	12:11:05.9	337	5	73	48	215	63	41	103	54	146
12	21 Jun. 2009	10:54:37.1	226	6	126	59	287	47	47	161	58	126
13	21 Jun. 2009	11:20:02.5	2	4	263	62	65	47	51	295	55	124
14	20 Jun. 2010	23:13:51.6	185	2	276	27	53	73	21	317	70	162
15	08 Feb. 2011	16:29:44.6	45	20	217	70	313	65	87	140	25	96
16	15 Aug. 2011	13:08:34.4	235	22	41	68	141	67	85	334	24	102
17	20 Aug. 2011	09:07:46.3	222	16	14	72	125	61	81	323	30	106
18	14 Dec. 2011	19:47:13.9	203	10	346	78	107	55	81	302	36	103
19	03 Aug. 2012	19:57:24.2	223	14	130	10	266	73	–2	357	87	–163
20	17 Jan. 2013	13:21:49.1	28	8	170	80	293	53	83	125	38	99
21	04 Feb. 2013	04:29:45.4	191	5	86	72	263	43	65	116	52	112
22	30 Jul. 2013	12:58:30.0	348	1	79	17	215	79	13	122	77	169
23	18 Nov. 2013	07:58:40.9	188	4	88	68	257	45	59	117	53	117
24	29 Dec. 2013	06:54:56.8	207	17	47	72	289	29	79	122	62	96
25	28 Jan. 2014	00:03:31.2	348	7	80	17	215	83	17	123	73	173
26	22 Apr. 2014	08:58:27.5	204	7	114	0	249	85	–4	339	85	–175
27	19 Jun. 2014	13:52:16.3	335	17	79	38	211	77	41	110	50	163
28	30 Aug. 2014	18:16:45.0	213	15	115	28	257	59	11	161	81	149
29	02 Oct. 2014	04:43:34.8	171	32	335	58	75	77	83	284	15	118
30	01 Apr. 2015	07:33:50.8	349	7	83	27	219	77	25	123	66	166
31	01 Nov. 2015	07:52:32.9	2	16	136	67	259	63	73	113	32	120

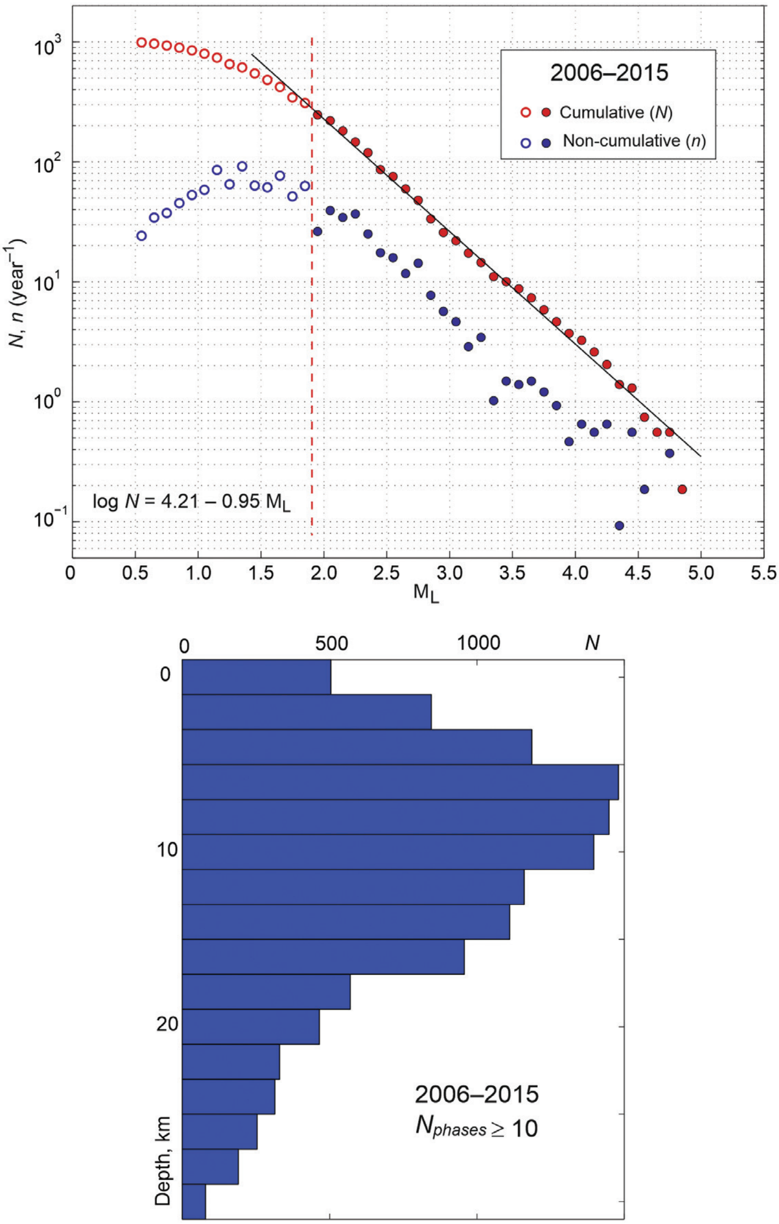

Figure 2. *Top*: Magnitude-frequency distributions for the Croatian Earthquake Catalogue (10663 mainshocks, $M_L \geq 0.5$) in the period 2006–2015. Cumulative (N, red circles) and noncumulative frequencies (n, blue circles) indicate completeness threshold at about $M_L = 1.9$. Full circles indicate magnitude classes assumed to be completely reported in the catalogue. *Bottom*: Histogram of focal depths, 2006–2015, only for earthquakes located with at least 10 phase onset readings, and excluding solutions with negative depths.

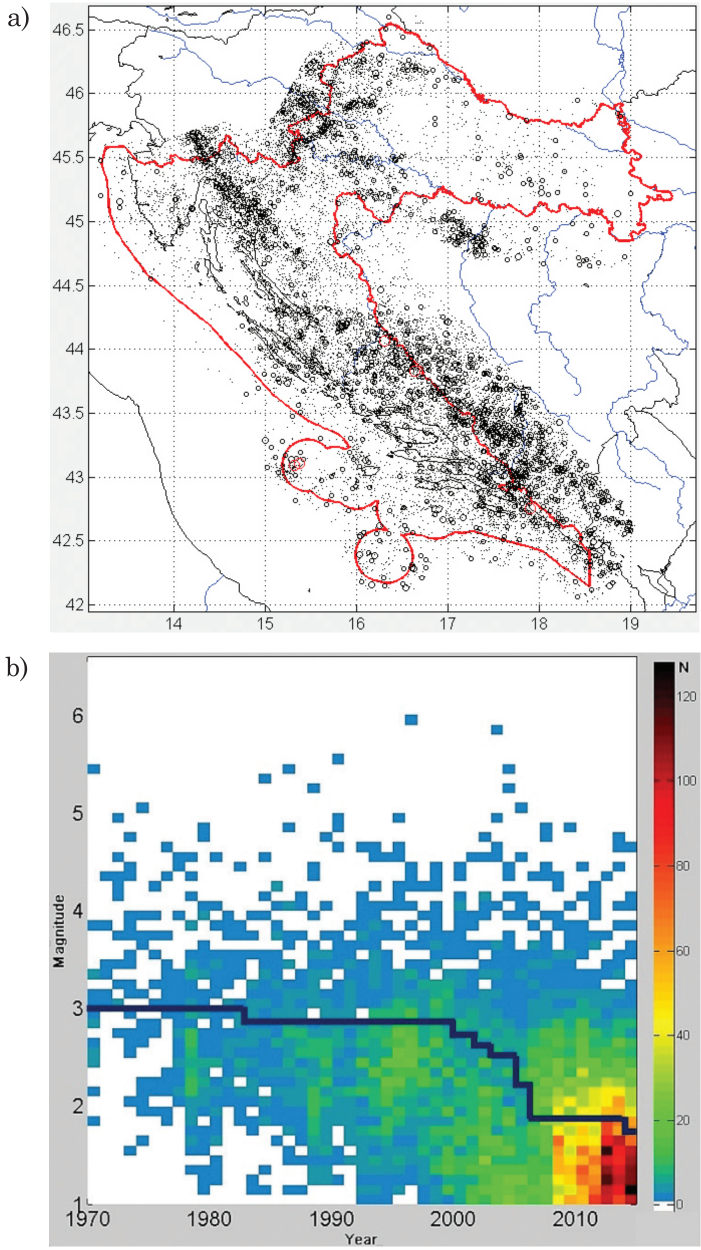

Figure 3. (*a*) Map of mainshock epicentres in Croatia and the surrounding areas in the period 1970–2015 and (*b*) the corresponding magnitude distribution timeline. Yearly number of mainshocks in the period 1970–2015, within bins 0.1 magnitude units wide is given by the colour scale. The thick blue line is the step-plot presentation of completeness thresholds (M_c) *vs*. time estimated as proposed by Herak et al. (2009).

from Croatian stations as well as from the seismograms available from the ORFEUS European Integrated Data Archive (EIDA, 2017). For some events amplitude ratios were also considered (for the method used see Herak et al., 2016). The obtained solutions are discussed in the following sections.

Macroseismic data were collected for all events felt in Croatia. The first information about effects of the earthquake were obtained from Civil Defence and web questionnaires which can be found on the web pages of the Department of Geophysics. The preliminary intensities were assessed by using this information. If the preliminary estimate of the epicentral intensity was five or more macroseismic data were obtained also by fieldwork. Macroseismic data for smaller events were collected only by questionnaires and phone interviews. Isoseismal and intensity maps for 10 earthquakes are presented in this paper. Intensities were estimated according to the MSK-78 scale (Medvedev et al., 1964; Medvedev, 1978; abbreviated here as MSK) with modifications by the Ad-hoc Panel (1981).

A total of 36733 earthquakes (for which at least six onset time-readings were available) were located in Croatia and the surrounding areas in the period 2006–2015 (Fig. 1(a)). The frequency-magnitude distributions for the declustered catalogue (mainshocks were extracted by space-time windowing as suggested by Herak et al., 2009) are presented in Fig. 2. The magnitude completeness threshold M_c for the analysed data was estimated at the lowest magnitude bin still obeying the log-linear distribution as $M_c = 1.9$, and the coefficient *b* of the Gutenberg-Richter relation is found to have a value of 0.95.

The magnitude completeness of the CEC was significantly improved during the period 2006–2015 due to considerable increase in the number of digital seismological stations. During the previous period 2002–2005 the Croatian Seismological Network consisted of only ten digital stations, and Ivančić et al. (2006) estimated the magnitude completeness threshold to be $M_c = 2.8$. The mainshocks listed in CEC since 1970 are displayed on Fig 3a. The timeline of magnitude distribution of these events and the corresponding estimated completeness thresholds M_c computed as suggested by Herak et al. (2009), are presented in Fig. 3b.

2.1. Instrumentation

Collection of earthquake related microseismic data was assembled by analysing seismograms recorded from permanent and temporary seismological stations in Croatia. During the observed period the Croatian Seismological Network consisted of the permanent Croatian State Seismological Network run by the Croatian Seismological Survey, its Zagreb-Net subnetwork (operating instruments owned by the City of Zagreb), and the stations installed within two Croatian research projects – Seismicity of Croatia (2006–2013), funded by the Ministry of Science, Education and Sports, and project VELEBIT (2015–2019) funded by the Croatian Science Foundation. All stations broadcast data to the central facility in Zagreb in real time. More information on all the stations is given in Tab. 3, while

Table 3. Summary of the stations meta-data of the Croatian Seismological Network operating during the 2006–2015 period. Stations that have changed net or belonging to more than one net have multiple entries with most recent at the bottom. Net acronims used: SoC – Seismicity of Croatia, CSN – Croatian State Network, VEL – Velebit net, ZAG – Zagreb Net.

Station	Code	Net	Lat. (°N)	Lon. (°E)	Alt. (m)	Sensor type	Operating since
Zagreb[1]	ZA1	CSN	45.815	15.972	157	Vicentini Wiechert (80 kg, 1000 kg, 1200 kg vertical)	1906 1908/1909
Zagreb	ZAG	CSN	45.8271	15.9869	179	Sprengnether 5100 BB, Güralp 40T	1983 11 Nov. 1999
Sisak[2]	SISC SISC	SoC VEL	45.4713	16.3718	125	BB, Güralp 40T	13 Jun. 2000
Hvar	HVAR	CSN	43.1776	16.4489	217	Vegik, Willmore MK-2 BB, Güralp 40T BB, STS-2	1973 21 Nov. 2000 11 Jan. 2005
Dubrovnik[3]	DBR	CSN	42.6473	18.0789	93	BB, Güralp 40T	27 Nov. 2000
Dubrovnik Golubov Kamen	DBRK	CSN	42.6691	18.1469	293	SP, Lennartz LE-3D/20s BB, Güralp 3ESP	28 Jul. 2011 19 Apr. 2012
Novalja	NVLJ NVLJ	SoC VEL	44.5635	14.8711	8	BB, Güralp 40T	31 Mar 2002
Rijeka	RIY	CSN	45.3251	14.4830	183	BB, Güralp 40T	25 Apr. 2002
Požega[4]	POZ	CSN	45.3324	17.6788	158	SP, Teledyne S13	03 Oct. 2003
Ston	STON STON	SoC VEL	42.8716	17.6999	4	BB, Güralp 40T	13 Oct. 2003
Kijevo	KIJV	CSN	44.0049	16.4047	471	BB, Güralp 40T	06 Apr. 2004
Puntijarka	PTJ	CSN	45.9073	15.9682	994	SKM-3, Sprengnether 5100 BB, Güralp 3ESP	1974 17 Jun. 2004
Veprinac[5]	VEP	CSN	45.3370	14.2787	494	BB, Güralp 40TD	10 Jul. 2008
Ričice	RICI	CSN	43.4944	17.1330	431	BB, Güralp 3ESPC	21 Apr. 2009
Udbina	UDBI UDBI	SoC VEL	44.5314	15.7694	832	BB, Güralp 40T	22 May 2009
Brijuni	BRJN	CSN	44.9057	13.7503	26	BB, Güralp 3ESPC BB, STS-2	04 Nov 2009 09 May 2013
Žirje	ZIRJ	CSN	43.6543	15.6439	107	BB, Güralp 3ESPC SP, Lennartz LE-3D/20s	11 Jun. 2010 11 Nov. 2014
Kalnik	KALN	ZAG	46.1312	16.4557	580	BB, Güralp 3ESPC	15 Jun. 2010.
Dugi Otok	DUGI	CSN	43.9918	15.0579	299	BB, Güralp 3ESPC	13 Jul. 2010
Ozalj	OZLJ OZLJ OZLJ	SoC ZAG VEL	45.6153	15.4673	155	BB, Güralp 40T	05 Jan. 2011
Morići	MORI	CSN	43.8660	15.7073	140	BB, Güralp 3ESPC	05 May 2011
Makarska	MAKA	CSN	43.2877	17.0197	45	BB, Güralp 40TD BB, Güralp 6TD	23 Oct. 2012 01 Nov. 2013
Moslavačka Gora	MOSL	ZAG	45.6135	16.7544	480	BB, Güralp 3ESPC	04 Sep. 2013
Lastovo	LSTV	CSN	42.7686	16.8919	130	BB, Güralp 3ESPC	02 Apr. 2014
Lobor	LOBO	ZAG	46.1551	16.0686	372	BB, Güralp 40T	30 Apr. 2015
Rab	RABC	VEL	44.7504	14.7821	16	BB, Güralp 40T	25 Jun. 2015
Sv. Marina	SMRN	VEL	45.0361	14.1549	17	BB, Güralp 6TD	24 Sep. 2015
Plitvice	PLIT	VEL	44.8784	15.6231	616	BB, Güralp 3ESPC	29 Sep. 2015

Note: 1 – station permanently closed 27 Mar. 1984, 2 – station permanently closed on 21 Mar. 2012, 3 – station inactive since 09 Feb. 2010 and relocated to Dubrovnik Golubov Kamen, and code changed to DBRK, 4 – station permanently closed on 19 Sep. 2009, 5 – station permanently closed on 04 Nov. 2009.

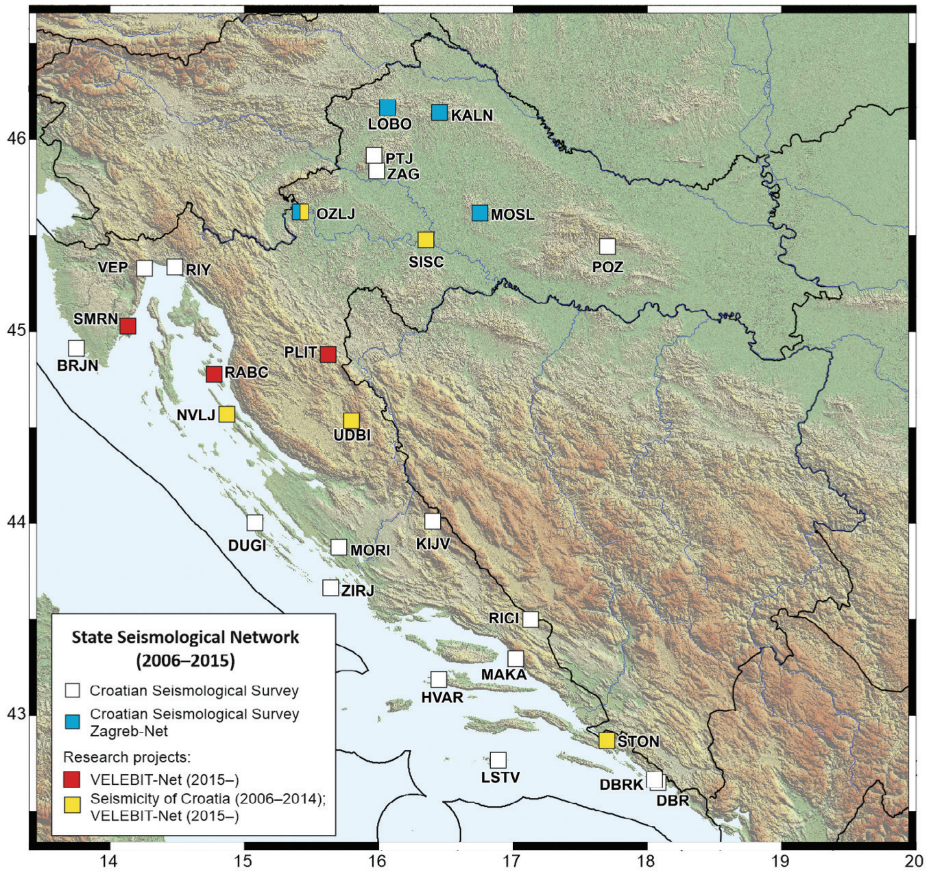

Figure 4. The Croatian Seismological Network during the 2006–2015 period. Tab. 3 shows operational periods and other detail for each station.

their locations, as well as the sub-networks they operated within, are shown in Fig. 4. The Croatian network relies mostly on BB Güralp instruments, with the exception of two Lennartz and two STS-2 seismographs. Also, a moving coil pick-up has been installed in 2009 on the horizontal Wiechert (1000 kg) instrument from 1909 in Zagreb, whose output is digitized and routinely recorded along with the modern broad-band instrument. Live Wiechert seismograms are available on: http://www.gfz.hr/Wiechert_seizmogrami/Wiechert_seizmogrami.htm.

3. Features of Croatian seismicity in the period 2006–2015

The analysis of Croatian seismicity is usually divided to two major areas (Markušić et al., 1990, 1993, 1998; Ivančić et al., 2002, 2006): (1) the continental part of Croatia, *i.e.* the southwestern part of the Pannonian Basin, northwestern and central Croatia, and (2) the coastal part of Croatia – Adriatic Sea, its NE coast and the External Dinarides.

3.1. Continental part of Croatia

The continental part of Croatia (Fig. 5) occupies the territory of the parts of northwestern Dinarides, the southwestern part of the Pannononian Basin and its western margins towards the Alpine domain. The interaction between the Adriatic microplate, the Dinarides, the Alps and the Pannonian basin led to rather complex tectonic and structural relationships. Well pronounced NW trend of both External and Internal Dinarides in the central part of this area (the main structural trends in the Vukomeričke Gorice, the Kupa and the Sava valleys are parallel to the major structural trend of the Dinarides) changes into NE-SW or even E–W oriented trend of inselbergs north of Zagreb (the largest of which are Medvednica, Kalnik and Ivanšćica Mts.; *e.g.* Šikić et al., 1977; Prelogović et al., 2003; Tomljenović et al., 2008; Ustaszewski et al., 2008, 2010).

Although the seismicity of these parts of Croatia is mostly of intraplate nature, and is thus characterised by rather rare occurrence of strong earthquakes, historical seismicity shows that its seismic potential is considerable. Figure 6 presents cumulative seismic moment release since the middle 17th century in the area shown in Fig. 5, excluding the events in the Dinarides, *i.e.* south of the

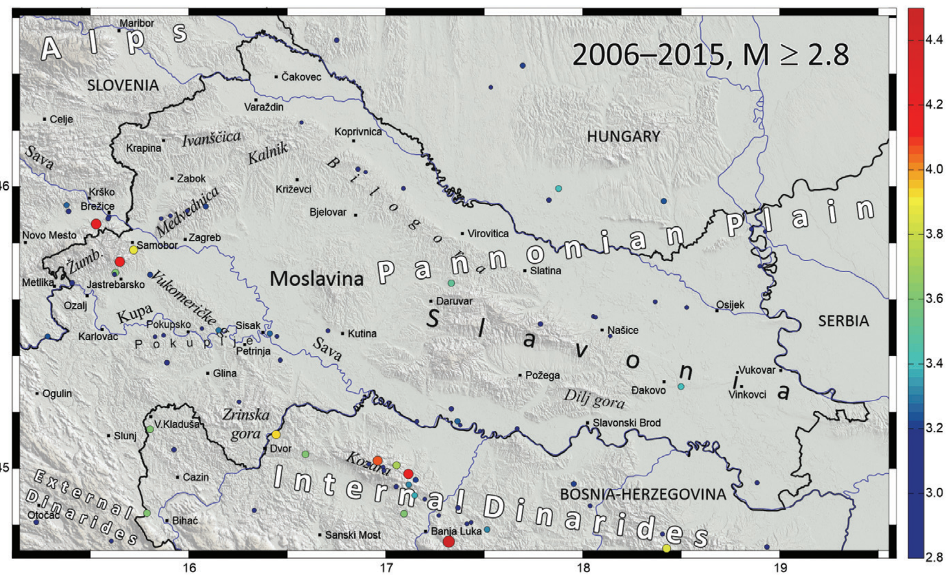

Figure 5. Events with $M_L \geq 2.8$ located during the 2006–2015 period in the continental part of Croatia. Magnitude is given by the colour scale.

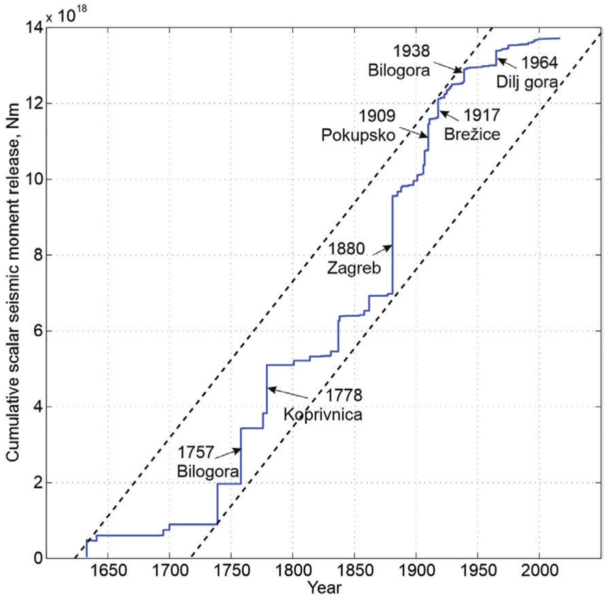

Figure 6. Cumulative scalar seismic moment release in the continental part of Croatia (the area covered by Fig. 5 north of the latitude of 45° N) computed assuming equivalence of M_L and M_w, and using the moment magnitude definition by Hanks and Kanamori (1979). Straight dashed lines' slope shows the average moment release rate since mid 17th century. Moment released in some important events is indicated by arrows.

latitude of 45° N. Scalar seismic moments were computed assuming equivalence of M_L and M_w, and using the moment magnitude definition by Hanks and Kanamori (1979). For historical events for which no microseismic data exist, the epicentral intensity was first converted to local magnitude M_L using the empirical relation (Herak, 1995):

$$M_L = 0.721\, I_0 + 1.283 \log h - 1.130,$$

where I_0 is epicentral intensity (°MSK), and h is the focal depth (assumed as 12 km if unknown, see Herak and Herak, 1990). The current long-term average moment release rate is about 3.5×10^{16} Nm/year, which is equivalent of one $M_w = 5.0$ event per year, or one $M_w = 6.4$ earthquake per century. Figure 6 also shows that the current moment release rate ever since the Brežice and Bilogora events of 1917 and 1938, respectively, is considerably lower than the long-term average. This indicates that the region is under the stress accumulation phase for the last 100 years.

The northwestern part of Croatia was seismically the most active area in the continental part of Croatia, with epicentres spreading from Bilogora Mt. and Koprivnica in the NW along the mountains Kalnik, Ivanščica, Medvednica, to Žumberak in the west, and from Pokuplje to Zrinska Gora in its southern parts.

Moslavina and Slavonia were characterised by mostly diffuse, weak to moderate seismicity (Figs. 1 and 5).

Seismic activity in the westernmost regions of this area (*Hrvatsko Zagorje* – the border region between Croatia and Slovenia and *Medvednica Mt.*) was relatively weak. Mostly isolated events occurred here, with the exception of the sequence of 43 weak earthquakes near Bistra in the period 21–31 August 2013. The earthquake with the largest magnitude (M_L = 2.8) occurred on 25 August 2013 at 22:39 with the maximum reported intensity of V °MSK in Bistra. Until the end of the year 18 more weak earthquakes were recorded in this epicentral area.

Epicentral area stretching from *Brežice* in Slovenia *to* Žumberak in Croatia was most active by the end of 2015. The strongest event here occurred on 1 November 2015 near Cerklje in Slovenia, about five kilometres from Croatian border, with magnitude M_L = 4.2. On the Croatian side of the border it was felt with the intensity of V °MSK in Grdanjci, Stojdraga, Budinjak, Gornja Vas and Gorica Svetojanska where strong shaking was felt, plates and bottles were shaking and pounding and many observers ran outdoors. In Budinjak, 1 mm wide cracks occurred in the plaster on the outside wall of a wooden house, and in Gornja Vas

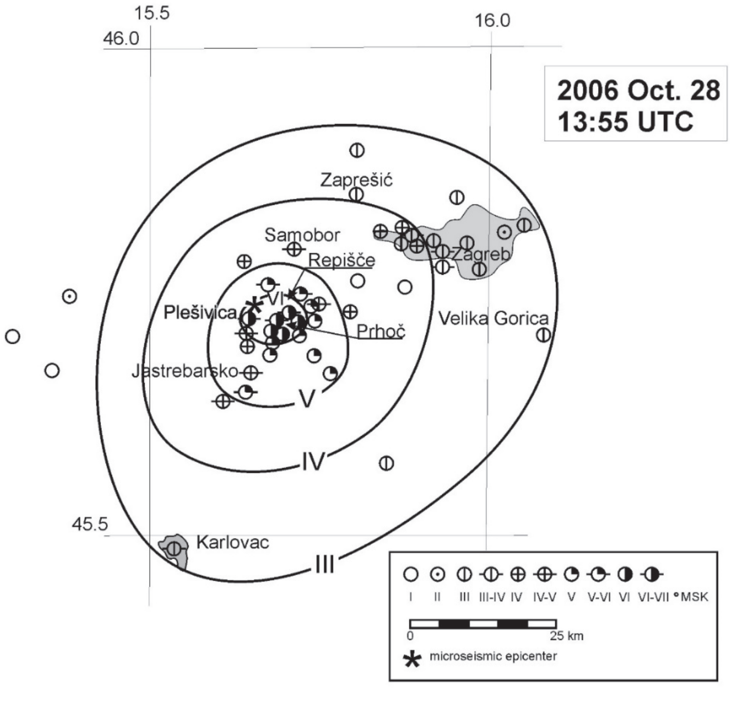

Figure 7. Isoseismal map for the Japetić earthquake of 28 October 2006 (13:55).

the asbestos roof panel cracked. Until the end of the year almost 800 weak aftershocks were recorded. Immediately after the mainshock two temporary stations were installed on the Croatian side of the border in Stojdraga (1–27 November 2015) and Željezno Žumberačko (1–25 November 2015), and Slovenian colleagues installed two instruments in Stojanski Vrh (1 November 2015 – 14 January 2016) and Županča vas (3 November 2015 – 14 January 2016). Records from Slovenian seismological network ARSO were obtained in cooperation with the Central and Eastern Europe Earthquake Research Network (CE3RN, 2016). The fault-plane solution (No. 31 in Fig. 1(b) and Tab. 2) indicates a predominantly reverse causative fault either steeply dipping to the N, or more gently to the SSW.

A strong event occurred near Japetić, between Samobor and Jastrebarsko, on 28 October 2006 at 13:55 UTC (all origin times in the paper given as UTC) with magnitude $M_L = 4.1$. The macroseismic field survey revealed that it was strongly felt in Plešivica, Prhoč and Repišće with the maximum intensity of VI–VII °MSK. This earthquake threw down some heavy (~50 kg) concrete chimney caps, and some tiles slipped from the roofs in Plešivica and Prhoč. The walls on the old church in Plešivica cracked. On several houses in Repišće chimneys

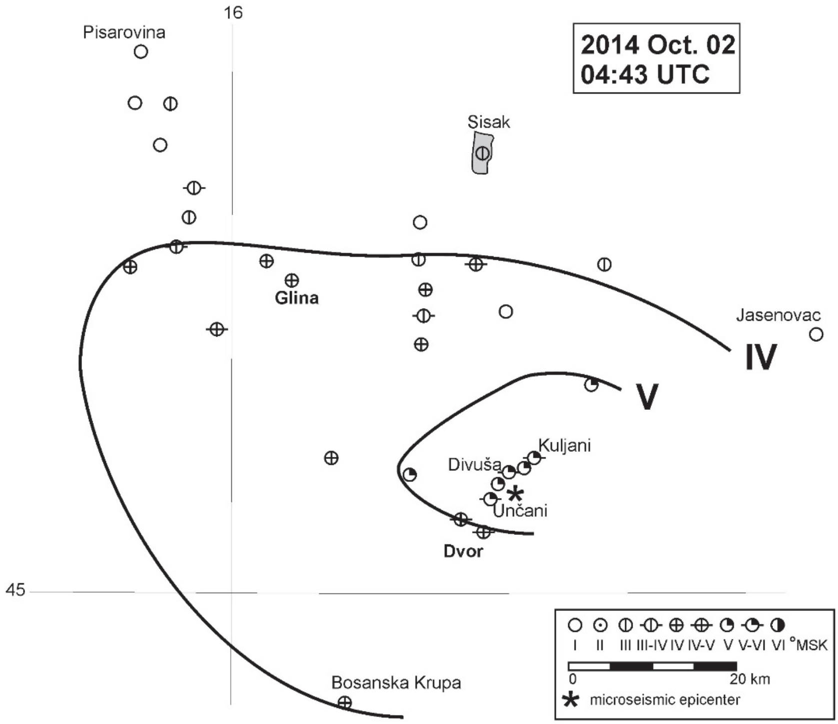

Figure 8. Isoseismal map for the Zrinska Gora earthquake of October 2, 2014 (4:43).

were slightly twisted. The distribution of the intensities assembled from the Croatian side is displayed in Fig. 7. The microseismic epicentre is located within the meizoseismal. The fault that generated this event (No. 2 in Fig. 1(b) and Tab. 2) was a strike-slip one – either a dextral one striking NW–SE, or the sinistral one striking NE–SW. This earthquake was preceded by several events of which the strongest ones occurred on 23 January 2006 with magnitude M_L = 3.9 and on 19 July 2006 with magnitude M_L = 3.6. (Figs. 1 and 5).

The seismicity in the *Pokuplje and Zrinska Gora mountain epicentral area* was characterized by notable occurrence of small events. Moderately frequent but weak earthquakes occurred in the vicinity of Sisak and along the Kupa river valley. The strongest earthquake in Zrinska Gora area occurred in the Una river valley on 2 October 2014 at 04:43, between Kuljani, Divuša and Unčani (M_L = 4.0, I_{max} = V–VI °MSK) on the Croatia – Bosnia and Herzegovina border. The distribution of the intensities assembled from the Croatian side is displayed in Fig. 8. Observers in the epicentral area stressed that they felt strong shaking, and many of them ran outdoors. The microseismic epicentre is located near Divuša, within the meizoseismal. The maximum intensity of V–VI °MSK was estimated in several villages between Divuša and Unčina. One vertical crack on a partition wall above a door and several cracks in plaster walls were observed in Divuša in the meizoseismal area. FPS (No. 29 in Fig. 1(b) and Tab. 2) points to a reverse faulting, either along a very steeply dipping fault striking WSW–ENE, or along an almost horizontal fault striking E–W.

Adjacent to the area of Zrinska Gora extends the Banja Luka epicentral area in Bosnia and Herzegovina well known by occasional intense seismic activity (*e.g.* the devastating Banja Luka earthquakes of 1969; Ustaszewski et al., 2014). During the observed period two earthquakes occurred beneath the Kozara Mt. in the vicinity of Banja Luka, both of magnitudes M_L = 4.1 (7 May 2009, at 12:11 and 28 January 2014, at 00:03). Their FPS (Nos. 11 and 25 in Fig. 1(b) and Tab. 2) show predominantly strike-slip mechanisms, most probably a steep WNW–ESE striking dextral fault.

3.2. Coastal part of Croatia

The coastal part of Croatia (Fig. 9) is tectonically complex area of the Adriatic microplate and External Dinarides. The broad contact zone of these tectonic units is where most of the earthquakes in Croatia occur.

The seismicity of the coastal part of Croatia is confined to the two clearly distinguishable domains that differ in the overall activity and seismic potential (*e.g.* see Ustaszewski et al., 2014). The NW one, approximately NW of Šibenik (see Fig. 9), comprises epicentral areas of Ilirska Bistrica–Rijeka–Senj (including parts of Lika, Gorski Kotar and Velika Kapela Mt.), Velebit Mt., Istria, Kornati islands, Zadar–Šibenik, and N. Adriatic). The much more active SE domain, includes epicentral areas of Dinara–Kamešnica Mt., Split, Ploče, Ston–Du-

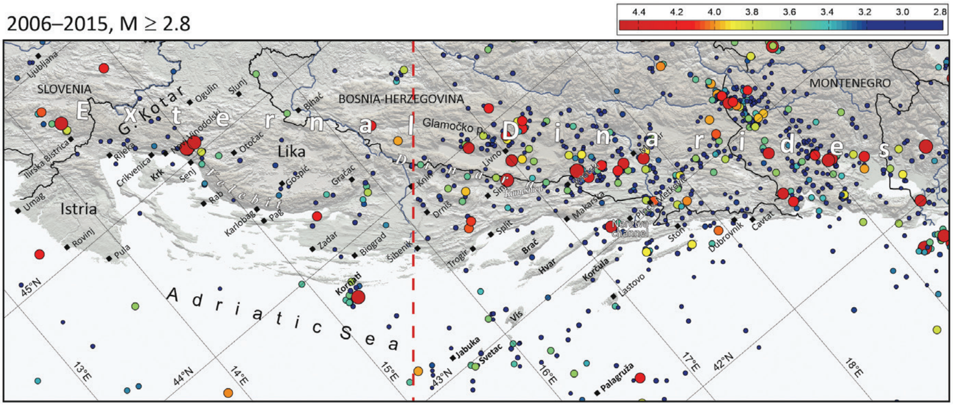

Figure 9. Events with $M_L \geq 2.8$ located during the 2006–2015 period in the coastal part of Croatia. Magnitude is given by colour scale at the top. The dashed red line divides the NW and the SE domains.

brovnik, Livno–Kupres, Imotski–Grude, Metković–Mostar, Glamočko Polje, Central Adriatic Sea, and Southern Adriatic Sea. Figure 10 presents cumulative scalar moment release in those two domains.

In the SE domain (Fig. 10a) the average moment release rate is about 5.8×10^{17} Nm/year, corresponding to an equivalent of one $M_w = 5.8$ earthquake

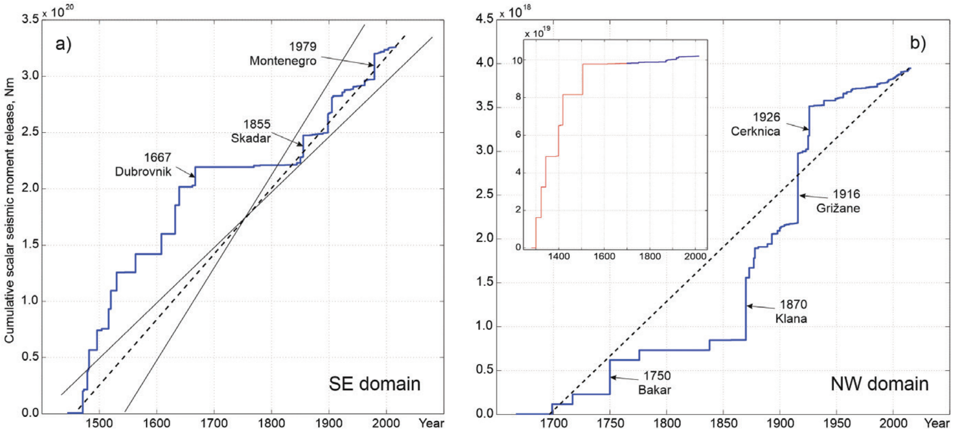

Figure 10. Cumulative scalar seismic moment release in the coastal part of Croatia (the area covered by Fig. 9, with the greater Ljubljana region excluded). (*a*) The SE domain (right of the red dashed line in Fig. 9). (*b*) The NW domain (left of the red dashed line in Fig. 9). Dashed lines' slope shows the average moment release rate in the considered time interval. Note different vertical scales in the two plots. The slopes of the full black lines in *a*) indicate the range of moment release rates estimated on the basis of the Adria-Dinarides convergence velocity (see text). The inset in *b*) shows estimated cumulative moment release from the 14th century until 2015. The blue part of the curve is zoomed into in the main axes.

per year since mid 15th century. The figure shows that the rate of moment release here was higher than average for about 200 years, until the great Dubrovnik earthquake that occurred in 1667. Afterwards the area was almost dormant for another two centuries, and the 'normal' seismicity with large earthquakes occurring every several decades resumed after the Skadar earthquake of 1855. The average moment release here is currently considerably lower than the long-term average.

It is interesting to compare the mean observed historical moment release rate to the one expected on the basis of known velocity of the Adria–Dinarides convergence estimated at u = 3–4 mm/year in this region (*e.g.* Battaglia et al., 2004; Serpelloni et al., 2005; D'Agostino et al., 2008; Weber et al., 2010). Considering the length of this zone ($L \approx 360$ km), the seismogenic layer depth of $D \approx 15$ km, average dip of the regional thrusts of $\delta \approx 45°$, average shear wave velocity and density of the uppermost crust of $\beta = 3.4$ km/s, and $\rho = 2600$ kg/m^3, respectively, and the seismic coupling coefficient $C = 0.7$–0.9 (Frohlich and Reiser Wetzel, 2007), average annual scalar moment release

$$M_0 = L\ D\ \beta_2\ \rho\ u\ C\ /\ \sin(\delta)$$

between $M_0 = 4.8 \times 10^{17}$ Nm/year and $M_0 = 8.3 \times 10^{17}$ Nm/year is obtained. This is in excellent agreement with the moment rate estimated above from historical seismicity.

The situation is considerably different in the NW domain (Fig. 10b) which exhibits considerably lower moment release rate of about 1.2×10^{16} Nm/year in the last 300 years, equivalent to one $M_w = 4.6$ event/year. Such a large difference between seismicity rates in the two domains is difficult to explain in terms of the Adria-Dinarides interaction. However, if one takes into account rather uncertain data from the catalogue extending back to the 14th century (see the inset in Fig. 10b), the overall picture changes, and indicates a possible seismic quiescence lasting for more than 500 years. Further elaboration of the problem of the low recent seismicity level here is outside the scope of this paper. Let's only note that the observed moment release in the last 90 years is considerably lower than the average in the last three centuries, and much lower than the complete historical record suggests.

During the 2006–2015 period about almost 10000 weak-to-moderate earthquakes were located in the NW domain of the coastal part of Croatia (see Fig 9). The most active here was the *Ilirska Bistrica–Rijeka–Senj epicentral area*, which spreads from Ilirska Bistrica in Slovenia towards the Krk Island, Crikvenicaand Senj, and includes parts of Gorski Kotar, Lika and Velika Kapela

Mt. Among several felt events only two were of magnitudes $M_L \geq 4.0$. The first one that occurred on 5 February 2007 at 8:30 with magnitude $M_L = 4.9$ and the maximum intensity I_{max} = VII °MSK close to Drežnica (Tab. 1) was the strongest earthquake in Croatia during the observed ten years period. The macroseismic field survey revealed that some walls cracked in the villages between Drežnica and Jezerane. The cracks were also found between prefabricated concrete elements on the school in Drežnica (about 30 years old building). Some landslides occurred on the road from Jasenak to Ledenice. The intensity distribution is shown in Fig. 11. The microseismic epicentre is located inunpopulated mountain area, out of the meizoseismal because the strongest intensities are caused by site effects in

Drežnica and Jasenak. Ilirska Bistrica–Vinodol fault is probably responsible for the occurrence of this earthquake (Fig. 1(a)), and the corresponding fault-plane solution (No. 4 in Fig. 1(b) and Tab. 2) in this case suggests predominantly strike-slip, right-lateral faulting mechanism.

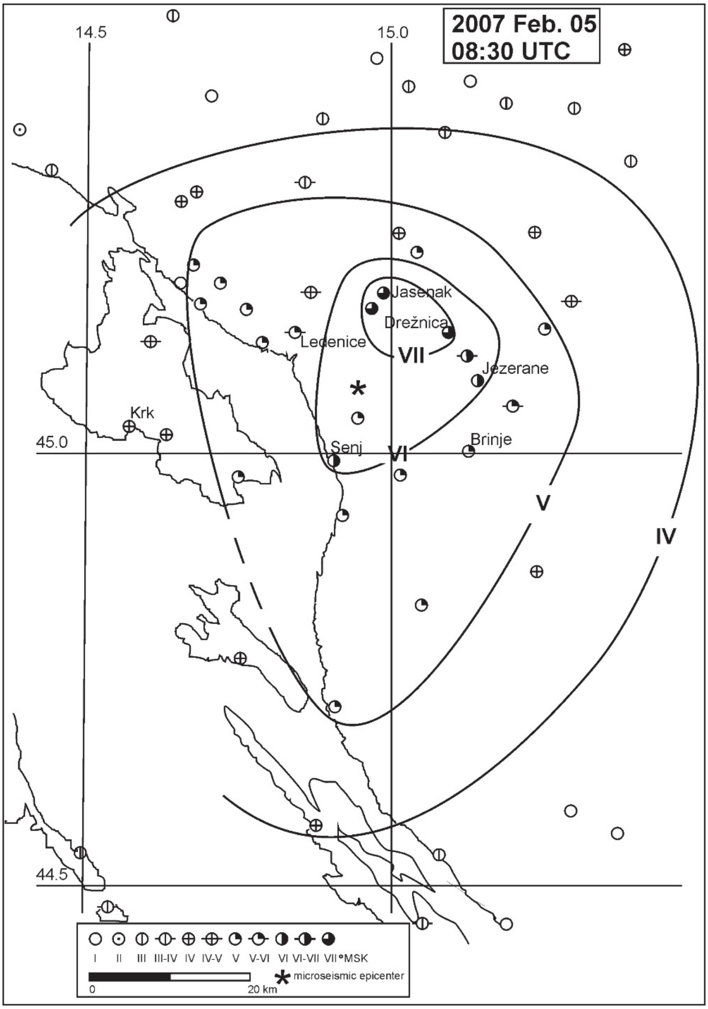

Figure 11. Isoseismal map for the Senj–Drežnica earthquake of 5 February 2007 (8:30).

The most numerous earthquake sequence in the Ilirska Bistrica–Rijeka–Senj epicentral area occurred in the vicinity of Senj. The strongest earthquake occurred on 6 May 2011 at 23:44 (M_L = 3.8). The maximum reported intensity was I_{max} = V–VI °MSK (Fig. 12) in Brlog (where a tile slipped from the roof of a newly built house, a framed picture overturned, and observers stressed that everything was shaking) and Kompolje (where a barn cracked, and some jars fell from the shelves in the local store). Until the end of the month 68 weak aftershocks were recorded.

On 30 July 2013 at 12:58 (Fig. 1(a) and Tab. 1) a strong earthquake with magnitude M_L = 4.8 and the maximum intensity I_{max} = VI °MSK occurred close to the source of the Senj-Drežnica event of 2007 (see above). Macroseismic investigations revealed that the highest intensities were observed in Brinje, where bottles tinkled and some of them fell off the shelves. Nine tiles moved on the roof of the post office building. Some observers ran outdoors. Observers in Križpolje

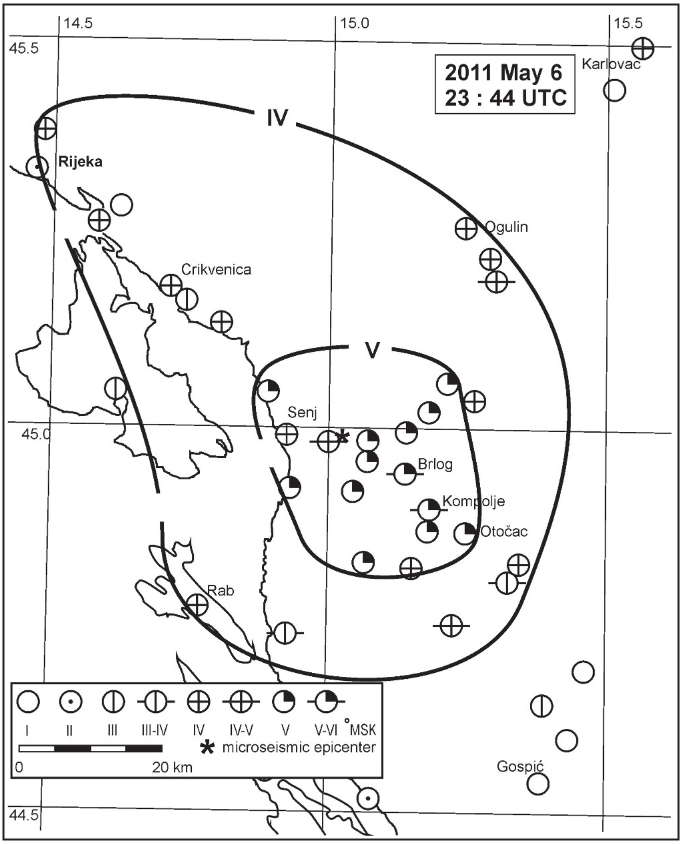

Figure 12. Isoseismal map for the Senj earthquake of 6 May 2011 (23:44).

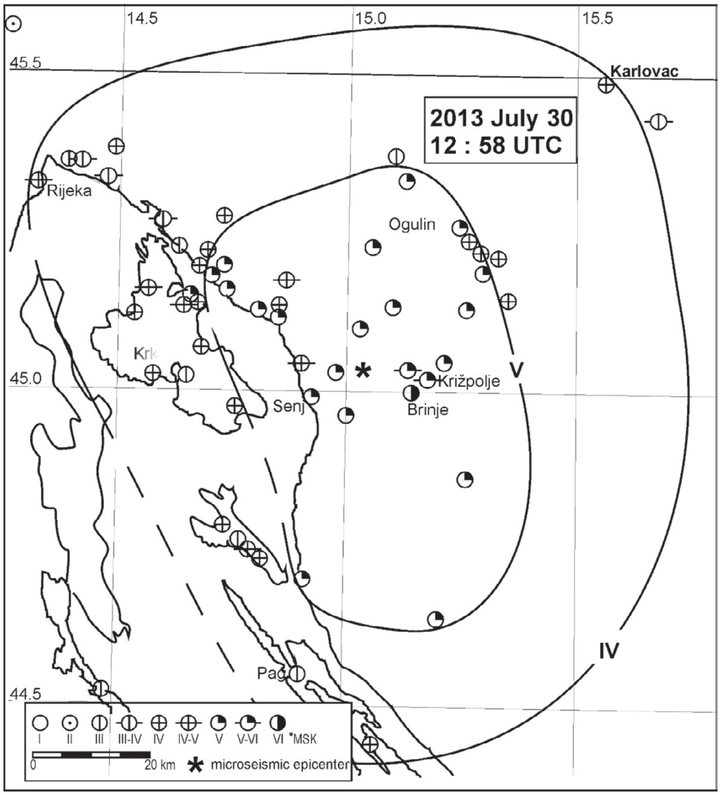

Figure 13. Isoseismal map for the Senj–Drežnica earthquake of 30 July 2013 (12:58).

stressed that they felt strong shaking, some of them even panicked. Some framed pictures fell from the walls. The intensity distribution is presented in Fig. 13. The microseismic epicentre is located within the meizoseismal near the Ilirska Bistrica–Vinodol fault which is most probable cause of this event. FPS (No. 22 in Fig. 1(b) and Tab. 2) is similar to the one of 5 February 2007 and is consistent with right-lateral strike slip faulting.

In the southern part of the *Velebit Mt. epicentral* area, in the Velebit channel, a felt earthquake (M_L = 4.1) occurred on 21 June 2009 at 10:54 near Vinjerac. Observers felt that the ground trembled under their feet, the windows were shaking vigorously, but there was no reported damage. The intensity distribution is presented in Fig. 14. The focal mechanism (No. 12 in Fig. 1(b) and Tab. 2) describes predominantly reverse faulting with a sinistral component if a fault striking ESE–WNW and dipping to the NNE is taken to be the source of this event. Alternative solution is the reverse fault with dextral component striking NNW–SSE and steeply dipping to the WSW.

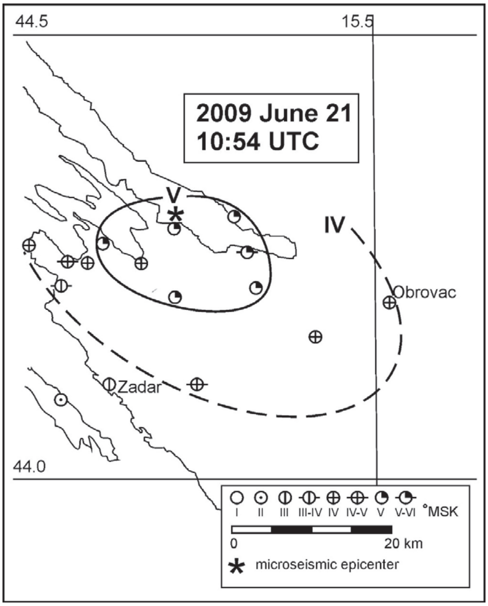

Figure 14. Isoseismal map for the Vinjerac earthquake of 21 June 2009 (10:54).

An earthquake with magnitude M_L = 4.1 was recorded on 13 August 2007, at 13:58 in the *northern Adriatic* submarine area near the Istrian peninsula, approximately 18 kilometres west from Rovinj and the Lim channel (No. 6 in Fig. 1(b) and Tab. 2). Because earthquake occurrence here is quite rare, and its epicentre lies close to the off-shore gas-field Ivana, it is possible that this event was induced by gas extraction. The FPS indicates that the P-axis strikes WNW–ESE, perpendicularly to the prevalent direction of the P-axes in the surrounding regions (*e.g.* Herak et al., 2016), which also suggests that local stress changes related to fluid extraction could have been responsible for the occurrence of this event. However, let's note that a similar mechanism was reported by Renner and Slejko (1994), some 45 km to the NNW. Another possibly gas-extraction induced event occurred in this area on 23 December 2008 at 19:07 (M_L = 3.7) about 70 km SSE from the epicentre of the 2007 quake. It's epicentre falls within the Ika gas field, again in the low-seismicity area within the Adriatic microplate.

The *Kornati islands* epicentral area, spreading about 25 km south-west from the Kornati archipelago into the Adriatic Sea, exhibited increased seismic activity during the 2006–2015 period. Out of the 90 recorded earthquakes, nine had magnitude $M_L \geq 3.0$. The strongest among them and the only one that exceeded magnitude 4.0, occurred on 18 July 2007 at 10:54 with magnitude M_L = 4.8 and the maximum intensity I_{max} = V °MSK estimated in the coastal towns Tkon, Biograd and Ždrilac. Its FPS (No. 5 in Fig. 1(b) and Tab. 2) indicates predominantly reverse faulting with a small dextral component if the W–E striking fault is accepted as the more probable over the one striking perpendicularly to the coastline.

The SE domain of the coastal part (see Fig. 9) is the most seismically active region in Croatia and its surroundings considered here. We were able to locate over 19000 earthquakes that occurred here between the years 2006 and 2015, with magnitudes up to 4.9. During the analysed period most of the earthquakes occurred in its northeastern parts, comprising the epicentral areas in Bosnia and Herzegovina and the border region with Croatia (epicentral areas of *Dinara–Kamešnica Mt., Livno–Kupres, Imotski–Grude, Metković–Mostar* and *Glamočko Polje*). The strongest one occurred in the *Imotski–Grude* epicentral area near Posušje in Bosnia and Hercegovina, on 21 June 2009 at 11:20, with magnitude M_L = 4.9. Its FPS (No. 13 in Fig. 1(b) and Tab. 2) suggests a reverse causative fault of Dinaric strike with some dextral component. The maximum intensity of VI °MSK was reported in Zagvozd, Imotski, Svib and Aržano. The intensity distribution is presented in Fig. 15. Two events had the magnitude M_L = 4.5. The

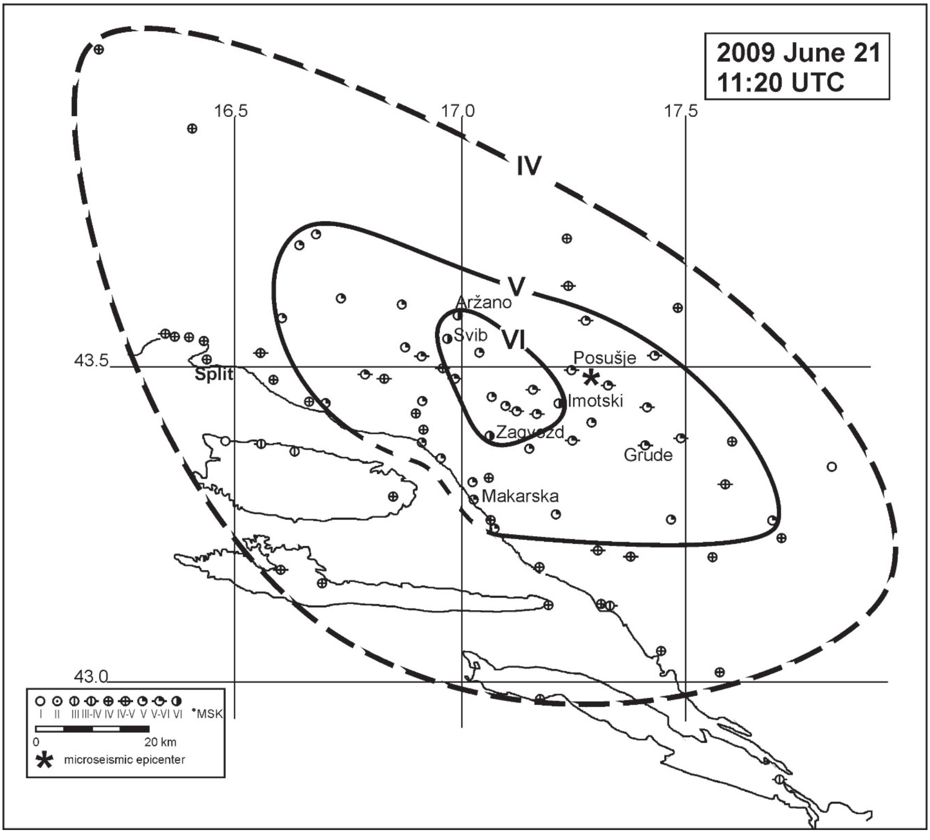

Figure 15. Isoseismal map for the Dinara Mt. earthquake of 21 June 2009 (11:20).

first one occurred on 18 October 2007, at 15:41, with the epicentre 7 km south of Mostar in Bosnia and Herzegovina, probably on a ESE–WNW striking, predominantly strike-slip fault (No. 7 in Fig. 1(b) and Tab. 2). The second one occurred in the *Livno–Kupres* epicentral area on 20 June 2010 in the vicinity of the Buško Blato lake near Livno, and FPS suggests mostly strike slip faulting on a steep dextral fault of Dinaric strike (No. 14 in Fig. 1(b) and Tab. 2). 15 more earthquakes with magnitudes ranging from 4.0 to 4.4 occurred here (Tab. 1), among which the most prominent seismicity is the one of the Glamočko Polje area. The most intense seismic activity occurred here during the August–October period in the year 2012, when a sequence of 600 weak earthquakes were recorded. The strongest among them occurred on 3 August 2012 at 19:57 near Glamoč, with magnitude M_L = 4.4. This was also a strike-slip event (No. 19 in Fig. 1(b) and Tab. 2), either on a S–N striking dextral fault, or on a E–W striking sinistral one.

On the Croatian side of the border area with Bosnia and Herzegovina, the event of magnitude M_L = 4.7 occurred on 18 November 2013 at 7:58 beneath the Kamešnica Mt. (Tab. 1). The maximum intensity of VI–VII °MSK was reported in Vržerale and Orguz in Bosnia and Herzegovina, where tiles slipped off the roofs, rocks tumbled down the hill, some walls cracked, and the gable end of an old house fell down. The intensity of VI °MSK was reported in Otok (some framed pictures fell down, some drywall panels cracked, one chandelier fell from the

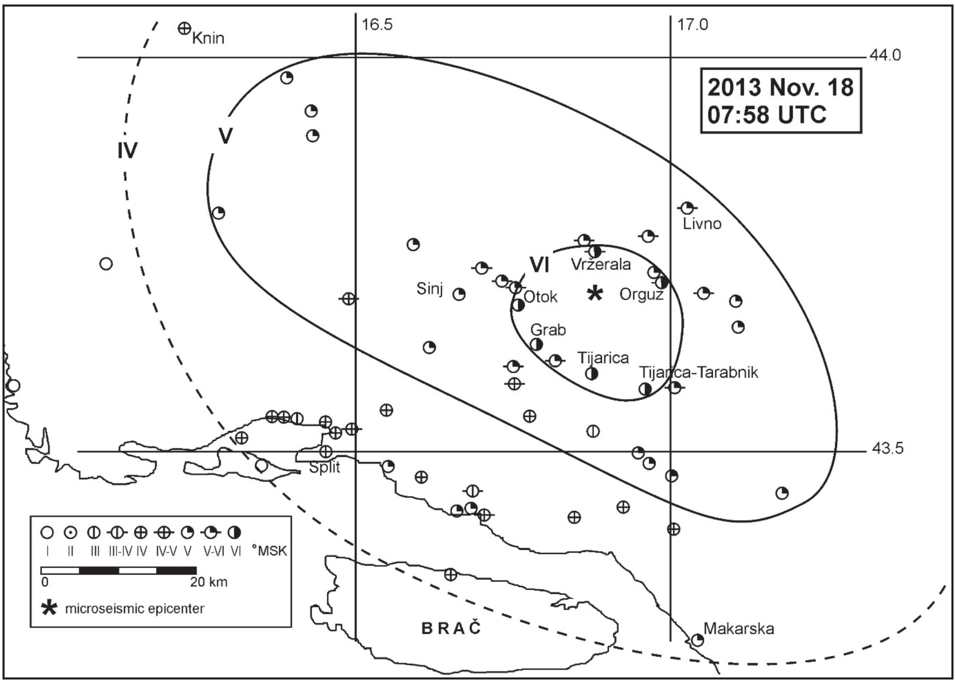

Figure 16. Isoseismal map for the Kamešnica Mt. earthquake of 18 November 2013 (7:58).

school ceiling and many people ran outdoors), Grab (walls cracked in the corners of an old house, and some tiles on the roof shifted), Tijarica and Tijarica-Tarabnik (where roof tiles rattled and slid, some walls and some nailed tiles on the roof cracked). The intensity distribution is shown in Fig. 16. The NW–SE elongation of the isoseismals corresponds to the preferred seismic energy propagation along the fault system of reverse faults striking mostly in the W–E to NW–SE direction (Imotski fault, Mosor Mt.–Biokovo Mt. fault, Fig. 1(a)), as it is generally true for earthquakes in the southern coastal part of Croatia. FPS (No. 23 in Fig. 1(b) and Tab. 2) presents mostly reverse faulting along the fault striking either E–W (dipping to the N), or WNW–ESE (dipping to the SSW).

The southern Croatian coastline area exhibited only moderate seismicity during the studied ten year period. The most active were *Split*, *Ploče* and *Ston–Dubrovnik* epicentral areas.

About 17 km northwest from Split, between Trogir and Muć, a sequence of 37 earthquakes was recorded during the first three months in 2013. The sequence started on 17 January with the first of two earthquakes with magnitude $M_L = 4.1$.

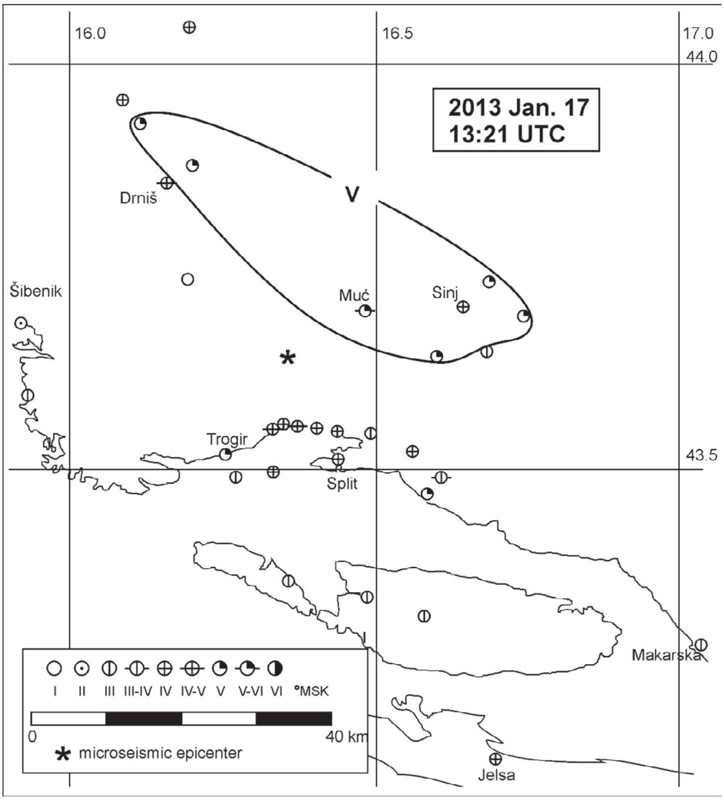

Figure 17. Isoseismal map for the Split earthquake of 17 January 2013 (13:21).

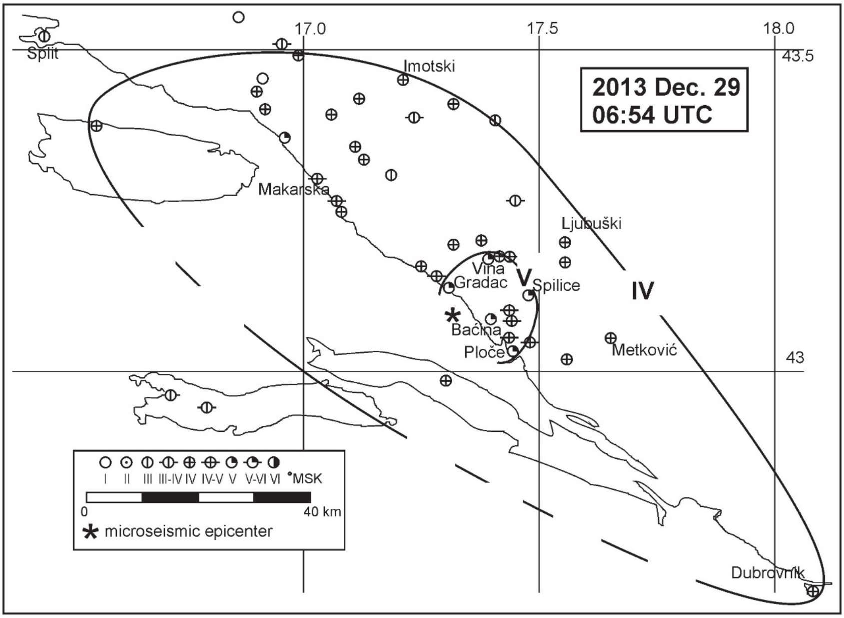

Figure 18. Isoseismal map for the Neretva Channel earthquake of 29 December 2013 (6:54).

It was felt with the maximum intensity of I_{max} = V–VI °MSK in Muć (Fig. 17). The second one occurred on 4 February 2013 (I_{max} = V °MSK). The FPS of the first earthquake (No. 20 in Fig. 1(b) and Tab. 2) points to the pure reverse faulting, Most probably on a fault dipping to the NNE.

Two more earthquakes with magnitudes larger than 4.0 were recorded in the Adriatic submarine area during the 2006–2015 period. The first of them occurred near Ploče in the Neretva Channel (29 December 2013, 6:54, M_L = 4.5) where it was felt with maximum intensity of I_{max} = V °MSK (in Ploče, Gradac, Baćina, Spilice and Vina), as presented in Fig. 18. Its FPS (No. 24 in Fig. 1(b) and Tab. 2) shows reverse faulting, most probably on a ESE–WNW striking, low-dipping fault. The second one occurred in the *Ston–Dubrovnik* area 4 km southwest from Lopud island near Dubrovnik (31 March 2008, 00:14, M_L = 4.0) where it was felt with the maximum intensity of I_{max} = V °MSK in Lopud, Šipanska Luka and Zaton Mali. The focal mechanism (No. 8 in Fig. 1(b) and Tab. 2) is similar to the previously mentioned one.

The *central Adriatic Sea epicentral area* exhibited weak seismicity during the observed period, with occurrence of relatively frequent but weak earthquakes (M_L = 3.9) in the three epicentral areas near the islands of Jabuka, Svetac and Vis. Following the two large earthquake sequences with the mainshocks that occurred on 29 March 2003 at 17:42 (M_L = 5.5), and on 25 November 2004 at 6:21, M_L = 5.2 (described by Herak et al., 2005, and Ivančić et al., 2006), during the observed period the seismicity near Jabuka island was low. Frequent occurrence of earthquakes near the island of Svetac started after March 2011, with three earthquakes with magnitudes exceeding 3.0 in April 2011 (the strongest one had magnitude M_L = 3.6). The Svetac island earthquake sequence lasted until the end of May (with 70 recorded earthquakes).

The seismicity of the Vis island epicentral area increased two years later, after the M_L = 3.6 magnitude earthquake on 10 January 2014. Out of 230 events recorded near Vis in the whole observed period, 170 occurred during the year of 2014.

The seismicity of the *southern part of the Adriatic Sea* was weak, with only one earthquake with magnitude larger than 4.0, which occurred approximately 30 km southeast from the Palagruža island on 4 June 2010, at 18:44, with M_L = 4.2.

4. Conclusions

Seismic activity of Croatia and its surrounding areas in the period 2006–2015 was weak to moderate and confined to the previously identified seismically active zones. The majority of 36733 located earthquakes occurred in the coastal region of Croatia. All well located earthquakes were shallow and occurred in the upper crust up to the depth of 20 km. The historical seismicity of both continental and coastal regions of Croatia shows that their seismic potential are considerable. It is noteworthy to observe that both regions seem to currently be in the strain accumulation phase.

The major update of equipment of the Croatian Seismological Network was carried out during the observed 2006–2015 period, and was accompanied by a substantial increase of number of digital seismological stations (from 10 permanent stations at the beginning of the year 2006 to 22 permanent digital seismographs at the end of the observed period), thus reducing the estimated magnitude completeness of the Croatian Earthquake Catalogue for Croatia and the surrounding areas from M_L = 2.8 (for the period 2002–2005) to M_L = 1.9 for the studied period.

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SAŽETAK

Seizmičnost Hrvatske u razdoblju 2006–2016.

Ines Ivančić, Davorka Herak, Marijan Herak, Ivo Allegretti, Tomislav Fiket, Krešimir Kuk, Snježana Markušić, Snježan Prevolnik, Ivica Sović, Iva Dasović i Josip Stipčević

Tijekom desetogodišnjeg razdoblja od 2006. do 2015. godine u Hrvatskoj i okolnim područjima locirano je 36 733 potresa, od toga 37 glavnih potresa s magnitudama u rasponu od 4,0 do 4,9. Seizmički najaktivniji je bio priobalni dio Hrvatske karakteriziran s dva različita područja seizmičke aktivnosti. U sjeverozapadnom priobalnom području, koje je u odnosu na ostatak obalnog područja bilo slabije seizmički aktivno, locirano je gotovo 10000 potresa, od čega je sedam potresa bilo magnitude $M_L \geq 4,0$, a među njima su i tri najjača potresa koja su se dogodila u Hrvatskoj tijekom promatranog razdoblja. Dva potresa imala su epicentar u Senjskom epicentralnom području. Prvi potres se dogodio 5. veljače 2007. u 8:30 UTC ($M_L = 4,9$, I_{max} = VII °MSK), a drugi 30. srpnja 2013. u 12:58 UTC, ($M_L = 4,8$, I_{max} = VI °MSK). Treći potres se dogodio u Kornatskom arhipelagu 18. srpnja 2007. u 10:54 UTC ($M_L = 4,8$). U jugoistočnom obalnom području dogodio se značajno najveći broj zabilježenih potresa (više od 19000 lociranih potresa, od čega 24 potresa magnitude $M_L \geq 4.0$, među kojima je najjači bio magnitude $M_L = 4,9$ s epicentrom u Bosni i Hercegovini u blizini hrvatske granice). Seizmičnost u kontinentalnom dijelu Hrvatske bila je slaba do umjerena s potresima magnitude $M_L \leq 4,1$. Žarišni mehanizmi potresa izračunati su za 31 potres s magnitudama $M_L \geq 4,0$. Potresi su makroseizmički analizirani. U usporedbi s dugoročnim prosjekom, trenutna relativno niska seizmička aktivnost mjerena oslobođenim seizmičkim momentom u jedinici vremena ukazuje da se oba dijela Hrvatske nalaze se u fazi akumuliranja tektonskih deformacija.

Ključne riječi: seizmičnost, Hrvatska, mehanizam pomaka u žarištu potresa, katalog potresa, makroseizmičke karte

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