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Seismic activity on the territory of Slovakia in 2020

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Abstract: The National Network of Seismic Stations of Slovakia (NNSS) consists of eight short period and six broadband permanent seismic stations and a data centre located at the Earth Science Institute of the Slovak Academy of Sciences (ESI SAS). The NNSS recorded and detected 11 229 seismic events from all epicentral distances in 2020. Totally 96 earthquakes originated in the territory of Slovakia in 2020. This paper provides basic information on the configuration of the NNSS, routine data processing, seismic activity on the territory of Slovakia in 2020 as well as macroseismic observations collected in 2020.

Key words: Slovakia, National Network of Seismic Stations, seismicity, macroseismic observations

1. Introduction

The seismic activity on the territory of Slovakia and adjacent areas has been reported on the daily basis by the so called Seismo Reports published on the web sites of the Department of Seismology, ESI SAS `http://www.seismology.sk/Seismo_Reports/reports.html` and in annual reports as a part of the project Partial monitoring system – Geological factors (*Liščák et al., 2021*, in preparation) which is solved with a contract between ESI SAS and State Geological Institute of Dionýz Štúr. The aim of this paper is to provide a quick overview of earthquakes which originated on the territory of Slovakia or were macroseismically felt on the territory of Slovakia in 2020.

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2. Seismic stations operating in 2020

The seismic monitoring of the Slovak territory is provided by the NNSS operated by the ESI SAS (*ESI SAS, 2004; Csicsay et al., 2018*), *Local Seismic Network in Eastern Slovakia* operated by the Faculty of Mathematics, Physics and Informatics of the Comenius University in Bratislava and local network of seismic stations around NPPs Jaslovské Bohunice and Mochovce operated by Progseis Ltd. company. The networks of seismic stations cooperate, and the exchange of data is on the regular basis. The positions of the seismic stations on the territory of Slovakia are shown in Fig. 1.

In 2020 the NNSS consisted of thirteen permanent seismic stations, from which eight are short period and six are broadband. Broadband stations are: Kolonické sedlo (KOLS), Modra (MODS), Skalnaté pleso (SPC), Vyhne (VYHS) and Bratislava – Železná studnička (ZST). Short period stations are: Hurbanovo (HRB), Izabela (IZAB), Iža (SRO1), Kečovo (KECS), Liptovská Anna (LANS), Moča (SRO2), Stebnícka Huta (STHS), Šrobárová (SRO). The HRB is the oldest NNSS seismic station that has been in operation since 1909 (*Pajdušák, 1997*). Broadband station Červenica (CRVS) located in Slanské Hills has been out of operation since 2018.

A new broadband station SPC has been built in cooperation with Institute of Geophysics of the Czech Academy of Sciences (GPI CAS) and

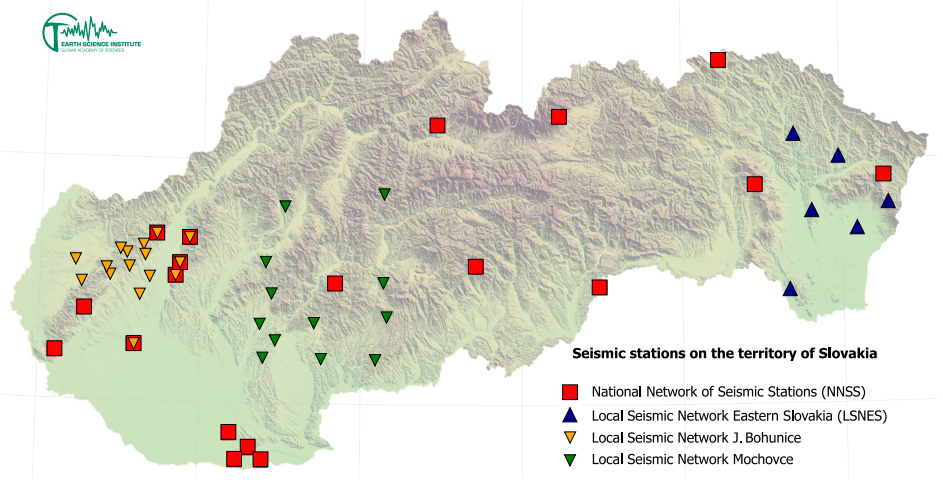

Fig. 1. Seismic stations operational on the territory of Slovakia in 2020.

officially put into operation on July 21, 2020. The station is installed with a broadband sensor Guralp-CMG40T-30s and a digitizer Earth data PR6-24. The NNSS permanent seismic stations and their instrumentation are summarized in Table 1. More details can be found on the web page `http://www.seismology.sk/National_Network`.

Four additional short period seismic stations have been operated on the jointly bases of ESI SAS and other institutions. The seismic stations Banka (BAN), Podolie (POD) and Jalšové (JAL) located in the Little Carpathians have been operated in cooperation with Progseis Ltd. company and the Institute of Rock Structure and Mechanics of the Czech Academy of Sciences (IRSM CAS) (*Fojtíková et al., 2015*). A new seismic station was built in Považský Inovec Mts. nearby the Tematin castle ruins (TEMA) in cooperation with the IRSM CAS. The seismic station in Pusté Úľany (PULA) has been under reconstruction. These stations have been installed as temporary seismic stations.

Table 1. Equipment of seismic stations of the NNSS operating in 2020.

Station	**ISC code**	**Lat. [°N]**	**Long. [°E]**	**Alt. [m]**	**Sensor**	**DAS**	**Sampl. freq.**	**Data format**
Bratislava Žel. Studnička	ZST	48.196	17.102	250	3×SKD	Wave32	100/sec	mSEED
Vyhne	VYHS	48.493	18.836	450	STS-2	Wave24	100/sec	mSEED
Modra-Piesok	MODS	48.373	17.277	520	STS-2	Wave32	100/sec	mSEED
Hurbanovo	HRB	47.873	18.192	115	2× Mainka	Analog	–	smoked paper
Izabela	IZAB	48.569	19.713	450	3×SM3	Wave24	100/sec	mSEED
Iža	SRO1	47.7622	18.2328	111	LE3D	PCM	20/sec	mSEED
Kečovo	KECS	48.483	20.486	345	LE3D	Wave24	100/sec	mSEED
Kolonické sedlo	KOLS	48.933	22.273	460	Guralp-6T-30s	Wave32	100/sec	mSEED
Liptovská Anna	LANS	49.151	19.468	710	LE3D	SEMS	100/sec	mSEED
Moča	SRO2	47.763	18.394	109	Guralp-40T-1s	Wave24	100/sec	mSEED
Stebnícka Huta	STHS	49.417	21.244	534	LE3D	Wave24	100/sec	mSEED
Šrobárová	SRO	47.813	18.313	150	3× SKM-3	Wave24	100/sec	mSEED
Skalnaté Pleso	SPC	49.189	20.234	1751	Guralp-40T-30s	SeisComp EarthData	100/sec	mSEED

3. Data processing

Digital data from all NNSS stations (except the analog seismic station HRB) are transferred in real-time to the data centre at the ESI SAS either by the internet or satellite telemetry. Software package SeisComp3 (*Weber et al., 2007*) and SeedLink server are used for data acquisition and exchange.

Beside observations from the NNSS stations the data center at ESI SAS also use the data from the above-mentioned local networks of seismic stations in Slovakia and observations from networks of neighbouring countries: Austrian Seismic Network (*ZAMG – Zentralanstalt für Meterologie und Geodynamik, 1987*), Czech Regional Seismic Network (*Institute of Geophysics, Academy of Sciences of the Czech Republic, 1973*), Hungarian National Seismological Network (*Kövesligethy Radó Seismological Observatory, 1992*), Local seismological network for monitoring NPP Dukovany (*Institute of Physics of the Earth Masaryk University, 2014*), GEOFON Seismic Network (*GEOFON Data Center, 1993*), *Polish Seismological Network*. These stations form a so-called Regional Virtual Network of ESI SAS that consists of approximately 55 seismic stations.

Routine analysis of the digital recordings at the ESI SAS has been performed by the Unix package Seismic handler (*Stammler, 1993*). Interactive locations of seismic events within Seismic Handler are performed by external program LocSat. The collected digital observations are manually processed on the daily basis. The epicentre locations are based on the IASP91 traveltime curves. Local magnitudes have been determined from the maximum vertical trace amplitudes of Sg waves, using the pre-defined Seismic Handler formula for local events. Continuous raw seismic data from the NNSS are stored in a local archive and seismic data interpretations (together with information on equipment of stations) are stored in a web accessible database.

4. Seismic activity in 2020

The NNSS analyzed 11 229 local, regional and teleseismic events in 2020. More than 35 000 seismic phases were determined. Seismic events identified as quarry blasts were excluded from further processing and were not included in the event statistics. All events recorded by the NNSS and analyses at the data centre at ESI SAS has been reported in the so called Seismo Reports and published on the above-mentioned web sites of the Department

of Seismology, ESI SAS.

Altogether 96 seismic events located by the NNSS originated in the territory of Slovakia in 2020 (Fig. 2). Known quarry blasts are not included in this number. 27 earthquakes reached local magnitude 1.0 or more and are listed in Table 2. The strongest earthquake occurred April 23 at 23:18 UTC in Vihorlat Mts. with local magnitude M_L 3.3.

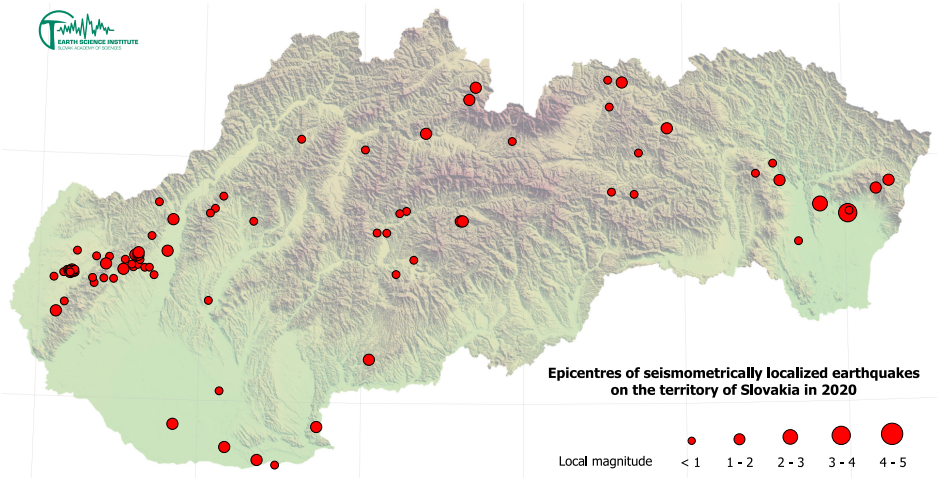

Fig. 2. Map of epicentres of local earthquakes originated on the territory of Slovakia in 2020. Diameters of the circles are proportional to local magnitudes.

The seismicity of the Slovak territory is dominated by the Little Carpathians and Komárno seismic source zones (*Hók et al., 2016*). The strongest earthquake in the Little Carpathians source zone was detected on the December 24 at 15:34 UTC with local magnitude M_L 1.6. The strongest earthquake in the Komárno source zone was detected on the August 15 at 6:22 UTC with local magnitude M_L 1.4. Although the low level of seismic activity from the last decades remained unchanged also in 2020, these two source zones remain of the primary interest for the monitoring of seismic activity within the territory of Slovakia.

5. Macroseismic observations

Six earthquakes were macroseismically felt on the territory of Slovakia in 2020 (Table 3), four of them with the epicentre on the territory of Slovakia

Table 2. List of earthquakes originated on the territory of Slovakia in 2020 with $M_L \geq 1.0$.

Date [YYYY-MM-DD]	**Origin Time (UTC) [HH:MM:SS]**	**Lat. [°N]**	**Lon. [°E]**	**Depth [km]**	M_L **[NNSS]**	I_0 **[°EMS]**	**Region**
2020-01-25	09:20:20.57	49.11	19.39	0	1.0		Liptov region
2020-02-08	20:42:26.23	48.51	17.19	0	1.7	3	Záhorie region
2020-02-13	16:28:14.40	48.52	17.20	2	1.0		Záhorie region
2020-03-01	10:57:54.91	48.35	17.11	0	1.0		Little Carpathians
2020-04-17	15:54:08.47	48.91	21.60	1	1.0		Slanské Hills
2020-04-23	23:18:27.21	48.77	22.02	16	3.3	5–6	Vihorlat Mts.
2020-04-30	03:59:05.65	48.81	21.85	8	2.3	4	Vihorlat Mts.
2020-06-11	22:19:58.39	48.18	19.05	0	1.0		Krupina Plain
2020-06-22	06:43:37.04	48.87	22.20	0	1.2		Vihorlat Mts.
2020-07-16	17:45:46.03	48.59	17.59	3	1.3		Little Carpathians
2020-07-22	10:57:28.47	49.32	20.62	0	1.3		Pieniny Mts.
2020-08-12	18:07:08.09	48.90	22.28	6	1.9		Vihorlat Mts.
2020-08-15	06:22:37.76	47.81	18.17	0	1.4		Šamorín – Komárno – Štúrovo
2020-08-20	03:53:22.61	48.53	17.52	2	1.2		Little Carpathians
2020-08-31	07:50:25.86	48.75	19.61	0	1.6	3	Vepor Mts.
2020-09-01	03:59:12.83	48.75	19.62	0	1.2		Vepor Mts.
2020-09-13	00:03:52.72	48.59	17.61	3	1.1		Little Carpathians
2020-09-15	08:58:39.66	49.13	20.90	10	1.6		Levoča Mts.
2020-09-20	07:37:25.65	47.90	17.85	12	1.3		Šamorín – Komárno – Štúrovo
2020-09-21	10:17:06.78	49.25	19.66	0	1.1		Western Tatras
2020-09-25	19:21:08.48	48.60	17.61	3	1.4		Little Carpathians
2020-10-09	10:24:17.22	49.30	19.70	0	1.4		Western Tatras

Table 2. Continued from the previous page.

Date [YYYY-MM-DD]	Origin Time (UTC) [HH:MM:SS]	Lat. [°N]	Lon. [°E]	Depth [km]	M_L [NNSS]	I_0 [°EMS]	Region
2020-10-29	09:39:48.38	48.61	17.79	0	1.2		Trnava Highlands
2020-11-30	08:42:33.49	47.90	18.73	5	1.4		Šamorín – Komárno – Štúrovo
2020-11-30	19:18:39.25	47.76	18.37	7	1.3		Šamorín – Komárno – Štúrovo
2020-12-24	15:34:02.40	48.74	17.82	5	1.6		Little Carpathians
2020-12-25	08:43:36.08	48.55	17.41	0	1.3		Little Carpathians

Table 3. List of macroseismically observed earthquakes on the territory of Slovakia in 2020.

Date [YYYY-MM-DD]	Origin Time (UTC) [HH:MM:SS]	Lat. [°N]	Lon. [°E]	Depth [km]	M_L [NNSS]	I_0 [°EMS]	Region
2020-02-08	20:42:26.2	48.51	17.19	0	1.7	3	Záhorie region
2020-03-22	05:24:02.8	45.87	16.02	10	5.2	3*	Croatia
2020-04-23	23:18:27.2	48.77	22.02	16	3.3	5–6	Vihorlat Mts.
2020-04-30	03:59:05.7	48.81	21.85	8	2.3	4	Vihorlat Mts.
2020-08-31	07:50:25.9	48.75	19.61	0	1.6	3	Vepor Mts.
2020-12-29	11:19:54.6	45.46	16.31	10	6.2	4*	Croatia

* highest intensity on the territory of Slovakia

(Fig. 3) and two of them on the territory of Croatia. All of these six earthquakes were also seismometrically observed and processed. Intensities were estimated by the European Macroseismic Scale 1998 (EMS-98) introduced by *Grünthal (1998)*.

The earthquake on February 8 at 20:42 UTC with epicentre in Záhorie region between municipalities Plavecké Podhradie and Studienka and local magnitude 1.7 was macroseismically felt on 2 locations (Table 4). 5 macroseimic questionnaires were filled. The epicentral intensity was determined at 3° EMS-98.

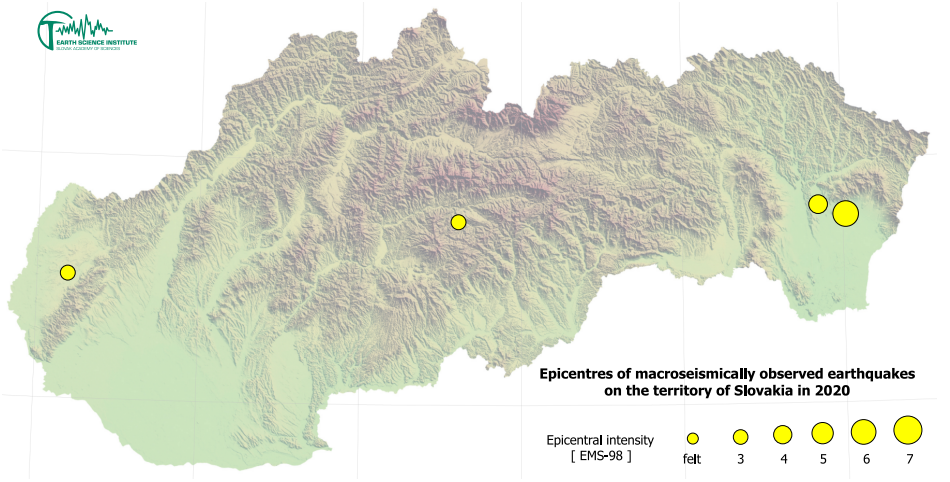

Fig. 3. Map of epicentres of macroseimically observed earthquakes on the territory of Slovakia in 2020. Diameters of the circles are proportional to epicentral intensity.

The earthquake on March 22 at 5:24 UTC with epicentre near Zagreb, Croatia and local magnitude 5.2 was macroseismically felt on 6 locations within the territory of Slovakia (Table 5). 24 macroseismic questionnaires were filled. People reported weak trembling on higher floors in municipalities Bratislava and Nové Zámky. The maximum intensity on the territory of Slovakia was determined at 3° EMS-98.

The earthquake on April 23 at 23:18 UTC with epicentre in Vihorlat Mts. located between municipalities Malé Zálužice and Lúčky and local magnitude 3.3 was macroseismically felt on 56 locations (Table 6). 544 macroseimic questionnaires were filled. People reported moderate shaking, cracks in walls, felt small pieces of plaster and partly damaged chimneys. The epicentral intensity was determined at 5–6° EMS-98. Due to the Covid-19 pandemics lockdown and travelling restrictions an on-site inspection of reported damages was not possible.

The earthquake on April 30 at 3:59 UTC with epicentre in Vihorlat Mts. located between municipalities Nacina Ves and Lesné and local magnitude 2.3 was macroseismically felt on 18 locations (Table 7). 70 macroseismic questionnaires were filled. The event was described as a trembling. Some people reported acoustic effects – rumble and shaking of light furniture. The epicentral intensity was determined at 4° EMS-98.

Table 4. Macroseismic observations for February 8, 2020 earthquake, 20:42 UTC.

Locality	**Lat.** [°**N**]	**Lon.** [°**E**]	**No. of questionnaires**	***I*** [°**EMS-98**]
Plavecký Mikuláš	48.519	17.306	4	3
Plavecký Peter	48.536	17.327	1	3

Table 5. Macroseismic observations for March 22, 2020 earthquake, 5:24 UTC.

Locality	**Lat.** [°**N**]	**Lon.** [°**E**]	**No. of questionnaires**	***I*** [°**EMS-98**]
Nové Zámky	47.993	18.170	12	3
Bratislava	48.163	17.126	7	3
Sereď	48.289	17.729	2	3
Komárno	47.766	18.118	1	3
Nové Mesto nad Váhom	48.758	17.829	1	3
Pezinok	48.298	17.270	1	3

Table 6. Macroseismic observations for April 23, 2020 earthquake, 23:18 UTC.

Locality	**Lat.** [°**N**]	**Lon.** [°**E**]	**No. of questionnaires**	***I*** [°**EMS-98**]
Michalovce	48.753	21.915	379	5–6
Zalužice	48.757	21.991	29	5–6
Petrovce nad Laborcom	48.794	21.868	7	5–6
Vinné	48.814	21.977	14	5
Hažín	48.752	22.021	10	5
Kaluža	48.806	22.006	5	5?
Betlenovce	48.729	21.903	2	5?
Močarany	48.739	21.872	2	5?
Šamudovce	48.708	21.888	2	5
Hatalov	48.659	21.889	1	5
Sobrance	48.756	22.189	1	5
Vrbnica	48.685	21.885	1	5?
Trnava pri Laborci	48.820	21.933	6	4–5
Veľké Zalužice	48.757	21.978	6	4–5
Nacina Ves	48.823	21.842	5	4-5
Krásnovce	48.722	21.901	3	4–5

Table 6. Continued from the previous page.

Locality	**Lat.** [°**N**]	**Lon.** [°**E**]	**No. of questionnaires**	***I*** [°**EMS-98**]
Lastomír	48.706	21.929	3	4–5
Čečehov	48.723	21.994	2	4–5
Lúčky	48.767	22.045	2	4–5
Sliepkovce	48.668	21.942	2	4–5
Meďov	48.737	21.936	1	4–5
Milovaná	48.763	21.866	2	4?
Veľké Revištia	48.750	22.109	2	4
Pichne	49.039	22.123	1	4
Suché	48.765	21.837	1	4
Rakovec nad Ondavou	48.771	21.786	3	3–4
Pozdišovce	48.728	21.857	8	3
Humenné	48.933	21.909	5	3
Strážske	48.874	21.833	4	3
Moravany	48.729	21.790	3	3
Trebišov	48.626	21.716	2	3
Beša	48.536	21.952	1	3
Brekov	48.902	21.838	1	3
Komárovce	48.654	21.650	1	3
Martin	49.087	18.915	1	3
Lučkovce	48.720	21.785	1	3
Poša	48.839	21.756	1	3
Vranov nad Topľou	48.882	21.689	2	3
Vyšný Žipov	48.987	21.590	1	3
Závadka	48.928	21.842	1	3
Žbince	48.671	21.887	1	3
Zemplínska Šírava	–	–	3	felt
Klokočov	48.813	22.032	2	felt
Topoľany	48.785	21.867	2	felt
Babin Potok	49.117	21.223	1	felt
Bajany	48.603	22.111	1	felt
Budkovce	48.629	21.944	1	felt

Table 6. Continued from the previous page.

Locality	**Lat.** [°**N**]	**Lon.** [°**E**]	**No. of questionnaires**	***I*** [°**EMS-98**]
Čerhov	48.461	21.644	1	felt
Dlhé Klčovo	48.812	21.739	1	felt
Jasenov	48.797	22.173	1	felt
Lesné	48.799	21.817	1	felt
Nižný Hrušov	48.810	21.776	1	felt
Porúbka	49.200	21.430	1	felt
Senné	48.665	22.030	1	felt
Vybúchanec	48.821	21.816	1	felt
Zbudza	48.816	21.895	1	felt

Table 7. Macroseismic observations for April 30, 2020 earthquake, 3:59 UTC.

Locality	**Lat.** [°**N**]	**Lon.** [°**E**]	**No. of questionnaires**	***I*** [°**EMS-98**]
Pusté Čemerné	48.843	21.819	7	4
Oreské	48.824	19.604	3	4
Trnava pri Laborci	48.820	21.933	5	3–4
Michalovce	48.753	21.915	9	3
Petrovce nad Laborcom	48.794	21.868	9	3
Vinné	48.814	21.977	9	3
Nacina Ves	48.823	21.842	4	3
Staré	48.412	21.903	4	3
Nižný Hrušov	48.810	21.776	3	3
Poša	48.839	21.756	3	3
Strážske	48.874	21.833	3	3
Zbudza	48.816	21.895	2	3
Zemplínska Šírava	48.787	22.012	1	3
Dlhé Klčovo	48.812	21.739	2	felt
Lesné	48.799	21.817	2	felt
Nižný Hrabovec	48.853	21.754	2	felt
Voľa	48.840	21.851	1	felt
Vybúchanec	48.821	21.816	1	felt

The earthquake on August 31 at 7:50 UTC with epicentre in Vepor Mts. located near municipality Čierny Balog and local magnitude 1.6 was macroseismically felt on 1 location (Table 8). One macroseimic questionnaire was filled. The epicentral intensity was determined at 3° EMS-98.

The earthquake on December 29 at 11:19 UTC with epicentre near Petrinja, Croatia and local magnitude 6.2 was macroseismically felt on 85 locations within the territory of Slovakia (Table 9). 682 macroseismic questionnaires were filled. People reported weak trembling on higher floors in municipalities Bratislava and Nitra. The maximum intensity on the territory of Slovakia was determined at 4° EMS-98.

Table 8. Macroseismic observations for August 31, 2020 earthquake, 7:50 UTC.

Locality	**Lat.** [°**N**]	**Lon.** [°**E**]	**No. of questionnaires**	***I*** [°**EMS-98**]
Brezno	48.813	19.660	1	3

Table 9. Macroseismic observations for December 29, 2020 earthquake, 11:19 UTC.

Locality	**Lat.** [°**N**]	**Lon.** [°**E**]	**No. of questionnaires**	***I*** [°**EMS-98**]
Lehnice	48.048	17.458	1	4
Bratislava 5	48.068	17.119	184	3
Bratislava 2	48.139	17.192	119	3
Bratislava 4	48.204	17.028	68	3
Bratislava 1	48.147	17.102	55	3
Nitra	48.314	18.092	34	3
Bratislava 3	48.207	17.147	20	3
Trnava	48.378	17.587	18	3
Nové Zámky	47.993	18.170	15	3
Sereď	48.289	17.729	15	3
Komárno	47.766	18.118	11	3
Levice	48.217	18.610	9	3
Pezinok	48.298	17.270	9	3
Šaľa	48.151	17.888	8	3
Banská Bystrica	48.733	19.143	7	3
Senec	48.243	17.380	6	3

Table 9. Continued from the previous page.

Locality	**Lat.** [°**N**]	**Lon.** [°**E**]	**No. of questionnaires**	***I*** [°**EMS-98**]
Nové Mesto nad Váhom	48.758	17.829	5	3
Trenčín	48.890	18.043	5	3
Dunajská Streda	47.996	17.617	4	3
Bernolákovo	48.200	17.300	3	3
Galanta	48.198	17.734	3	3
Hlohovec	48.431	17.798	3	3
Martin	49.087	18.915	3	3
Michalovce	48.753	21.915	3	3
Stupava	48.269	17.023	3	3
Topoľčany	48.561	18.174	3	3
Dunajská Lužná	48.083	17.265	2	3
Lučenec	48.332	19.664	2	3
Modra	48.347	17.313	2	3
Partizánske	48.641	18.589	2	3
Piešťany	48.594	17.824	2	3
Rovinka	48.098	17.237	2	3
Slovenský Grob	48.256	17.279	2	3
Šamorín	48.025	17.339	2	3
Balog nad Ipľom	48.078	19.133	1	3
Bobrovec	49.122	19.616	1	3
Bohdanovce nad Trnavou	48.424	17.541	1	3
Borský Mikuláš	48.622	17.205	1	3
Báb	48.307	17.880	1	3
Čachtice	48.713	17.789	1	3
Dlhá nad Váhom	48.171	17.863	1	3
Dudince	48.169	18.885	1	3
Holíč	48.810	17.161	1	3
Horné Saliby	48.111	17.761	1	3
Horné Trhovište	48.468	17.869	1	3
Hronovce	48.003	18.645	1	3
Ivančiná	48.911	18.814	1	3

Table 9. Continued from the previous page.

Locality	**Lat.** [°**N**]	**Lon.** [°**E**]	**No. of questionnaires**	***I*** [°**EMS-98**]
Kmeťovce	48.262	18.708	1	3
Kovarce	48.498	18.157	1	3
Košice	48.711	21.254	1	3
Kúty	48.659	17.021	1	3
Láb	48.364	16.974	1	3
Malacky	48.436	17.024	1	3
Matúškovo	48.168	17.733	1	3
Miloslavov	48.096	17.307	1	3
Mojzesovo	48.134	18.239	1	3
Most pri Bratislave	48.136	17.285	1	3
Močenok	48.226	17.931	1	3
Nová Dedinka	48.185	17.356	1	3
Nána	47.815	18.695	1	3
Opoj	48.303	17.643	1	3
Osuské	48.623	17.451	1	3
Pribeta	47.924	18.303	1	3
Prievidza	48.772	18.626	1	3
Strekov	47.895	18.394	1	3
Špačince	48.441	17.612	1	3
Tehla	48.186	18.389	1	3
Topoľčianky	48.423	18.412	1	3
Tvrdošovce	48.093	18.037	1	3
Valaliky	48.641	21.301	1	3
Velčice	48.415	18.305	1	3
Veľké Lovce	48.061	18.338	1	3
Veľké Úľany	48.143	17.582	1	3
Veľký Krtíš	48.214	19.350	1	3
Zvolen	48.572	19.140	1	3
Žiar nad Hronom	48.582	18.853	1	3
Žihárec	48.073	17.882	1	3
Štúrovo	47.804	18.698	2	felt

Table 9. Continued from the previous page.

Locality	**Lat.** [°**N**]	**Lon.** [°**E**]	**No. of questionnaires**	***I*** [°**EMS-98**]
Medveďov	47.800	17.663	1	felt
Nováky	48.725	18.544	1	felt
Nový Gúg	47.969	18.108	1	felt
Okoč	47.912	17.825	1	felt
Púchov	49.124	18.326	1	felt
Studienka	48.527	17.137	1	felt
Šaštín-Stráže	48.643	17.147	1	felt

6. Conclusion and discussion

The NNSS is operated by the ESI SAS, Bratislava. Data from all stations (except station HRB) are transferred in real-time to the data centre at Bratislava. Data processing and routine analysis are performed digitally by interactive seismological software Seismic Handler. Digital data are accessible both on-line and off-line in standard data format. So called Seismo Reports of seismic events recorded by NNSS are published on the web page of the ESI SAS `http://www.seismology.sk/Seismo_Reports/reports.html`.

In 2020 financial injection from the Slovak Academy of Sciences for the upgrade of the old instrumentation has been received. Thanks to this financal aid ESI SAS will be able to upgrade the equiment of seismic stations LANS and SRO next years.

Maintenance of seismic stations and routine daily interpretation of seismic data in 2020 were influenced by Covid-19 pandemics. On-site service of instrumentation was performed in emergency cases only. Photographical documentation of damages caused by April 23, 2020 earthquake in Vihorlat region (as recommended by EMS-98 manual; *Grünthal, 1998*) was not taken due to travelling restriction. Therefore, macroseicmic intensities for this earthquake were evaluated from the macroseismic questionnaires only.

Epicentres and local magnitudes were determined for 91 earthquakes originated on the territory of Slovakia in 2020. Weak seismic activity was recorded from several seismic source zones: Little Carpathians, Komárno, Vihorlat Mts., Vepor Mts., Záhorie region and Western Tatras.

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