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## Rapid Multi-Risk Needs Evaluation and Planning Platform

101193586 - EMERGE - UCPM-2024-KAPP-PV

### CBR Ground Shaking Map

Evaluation of CBR Strong Motion capacities and ORFEUS-EIDA  
Integration

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## Executive summary

Deliverable D4.1 presents the cumulative results of the activities carried out in tasks T4.1 (CBR Strong Motion Capacities) coordinated by AUTH and T4.2 (Integration of CBR Strong Motion Monitoring Capacities) coordinated by NOA. Following the introductory Chapter 1, Chapter 2 compiles the results of Task T4.1, focusing on the documentation and evaluation of the existing strong motion network capacities within the CBR, as well as providing recommendations for the potential enhancement of both the number and the operational quality of active strong motion stations in the region. Chapter 3 presents the principal outcomes of Task T4.2 including the integration of the strong motion network of North Macedonia into the ORFEUS-EIDA platform through NOA's regional node, and the selection of suitable NOA accelerometric stations located in the vicinity of the CBR for real-time data sharing with UKIM-IZIIS. The main findings and conclusions of the deliverable are summarized in Chapter 4.

## 1. Introduction

Deliverable D4.1 presents cumulative results from the efforts made in Tasks T4.1 coordinated by AUTH and T4.2 coordinated by NOA. Chapter 2 compiles the results from T4.1 (CBR Strong Motion Capacities) on the evaluation and assessment process for the existing CBR strong motion capacity aiming at a clear presentation of the available accelerometric stations in the region and their status. Based on the findings of this evaluation, recommendations are made to optimally enhance both the quantity and quality of active strong motion stations. Chapter 3 includes the main results of T4.2 (Integration of CBR Strong Motion Monitoring Capacities). More specifically, the process of the integration of the strong motion network of North Macedonia into the ORFEUS-EIDA platform through NOA's regional node is presented. This integration will enable public access to data collected from the N. Macedonian national network and will enhance and streamline the exchange of relevant data among project partners and through ORFEUS-EIDA to the public. In addition, Chapter 3 describes the selection process of NOA accelerometric stations in the vicinity of the CBR to be shared with UKIM-IZIIS in real time through a Memorandum of Understanding (MoU) signed between NOA and UKIM-IZIIS in January 2026 (attached in Annex 1) and Memorandum of cooperation (MOC) on bilateral seismic data exchange and scientific collaboration signed between IGEO and UKIM-IZIIS in October 2025 (attached in Annex 2). The main results of the report are summarized in Chapter 4.

## 2. Documentation, evaluation and recommendations for potential enhancement of CBR strong motion network capacities

### 2.1. Greece

#### 2.1.1. Existing networks and monitoring infrastructure

In Greece, the following regional and national networks exist and provide their waveform data through the EIDA@NOA node (Evangelidis et al., 2021), the National and Regional EIDA Node in the Southeastern Mediterranean:

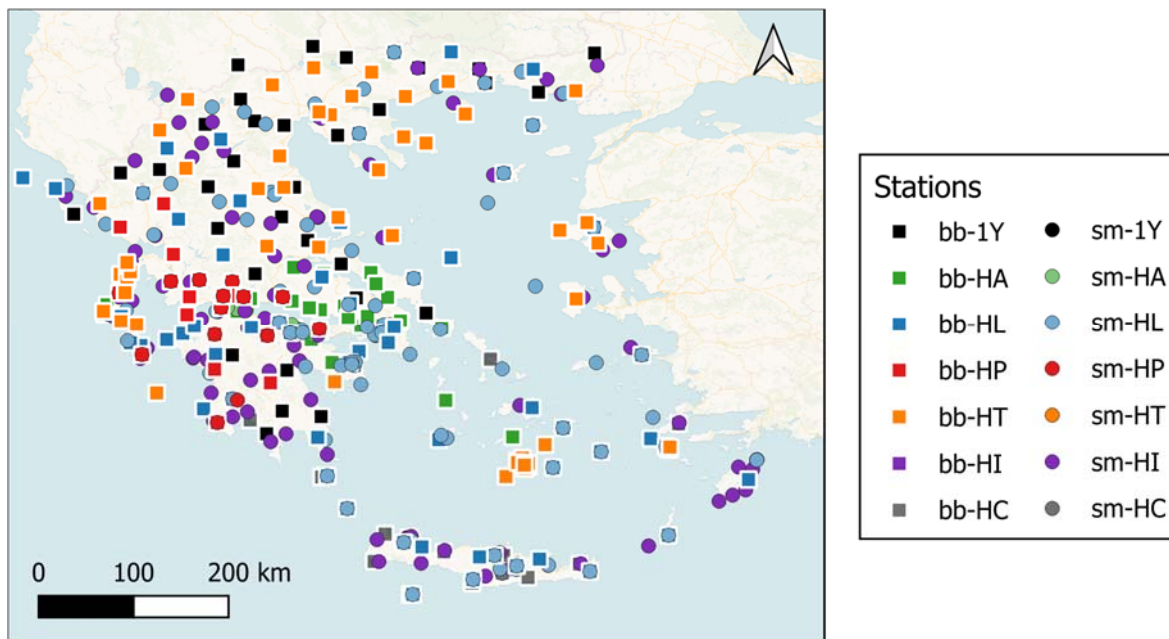
- HL: National Observatory of Athens, Institute of Geodynamics (<https://www.fdsn.org/networks/detail/HL/>; NOA, 1975): on 12/1/2025, HL network comprised 99 broadband seismometer stations (HH channel) and 97 strong-motion accelerometric stations (HN channels) throughout Greece. Some of the stations are collocated.

We note that 75 more HN stations exist that do not transmit data continuously to EIDA@NOA, but operate on a triggering mode, pending replacement/upgrade. 16 sensors are of the A800 or A900 type, and 18 sensors are of the QDR type. Also, several (41) old triggering-mode stations have already recently been replaced by P-alert low-cost sensors that are not yet connected to EIDA@NOA. The current status of HN sensors can be found here: <https://accelnet.gein.noa.gr/station--information/>. We do not consider at all here the special accelerometric network of the Acropolis, consisting of 11 stations on and around the monument.

- HP: University of Patras, Department of Geology (<https://www.fdsn.org/networks/detail/HP/>; UPAT, 2000): on 12/1/2025, HP network comprised 26 broadband seismometer stations (HH channel) and 19 strong-motion accelerometric stations (HN channels). Most of the stations are collocated in Western Greece.
- HT: University of Thessaloniki, Department of Geology (<https://www.fdsn.org/networks/detail/HT/>; AUTH, 1981): on 12/1/2025, HT network comprised 66 broadband seismometer stations (HH channel) in Northern-central Greece.
- HA: National Kapodistrian University of Athens, Department of Geology (<https://www.fdsn.org/networks/detail/HA/>; UOA, 2008): on 12/1/2025, HA network comprised 37 broadband seismometer stations (HH channel) around Attica and central Greece.
- HC: University of Crete (<https://www.fdsn.org/networks/detail/HC/>; TEICrete): on 12/1/2025, HC network comprised 23 broadband seismometer stations (HH channel) around Crete.
- HI: Institute of Engineering Seismology and Earthquake Engineering - ITSAK (<https://www.fdsn.org/networks/detail/HI/>; ITSAK, 1981): on 12/1/2025, HI network comprised 121 strong-motion accelerometric stations (HN channels) throughout Greece.
- 1Y: the temporary AdriaArray ([https://www.fdsn.org/networks/detail/1Y\\_2022/](https://www.fdsn.org/networks/detail/1Y_2022/); Friederich et al., 2022): on 12/1/2025, 1Y network comprised 34 broadband seismometer stations (HH channel) throughout mainland Greece.

All of the above networks amount to 522 stations throughout Greece at the time of writing this report connected to EIDA@NOA (**Table 1**), and 608 overall. Figure 1 shows all these networks across Greece.

The first six networks in the list above comprise the Hellenic Unified Seismic Network (HUSN - [https://bbnet2.gein.noa.gr/husn\\_network/index\\_en.html](https://bbnet2.gein.noa.gr/husn_network/index_en.html)).



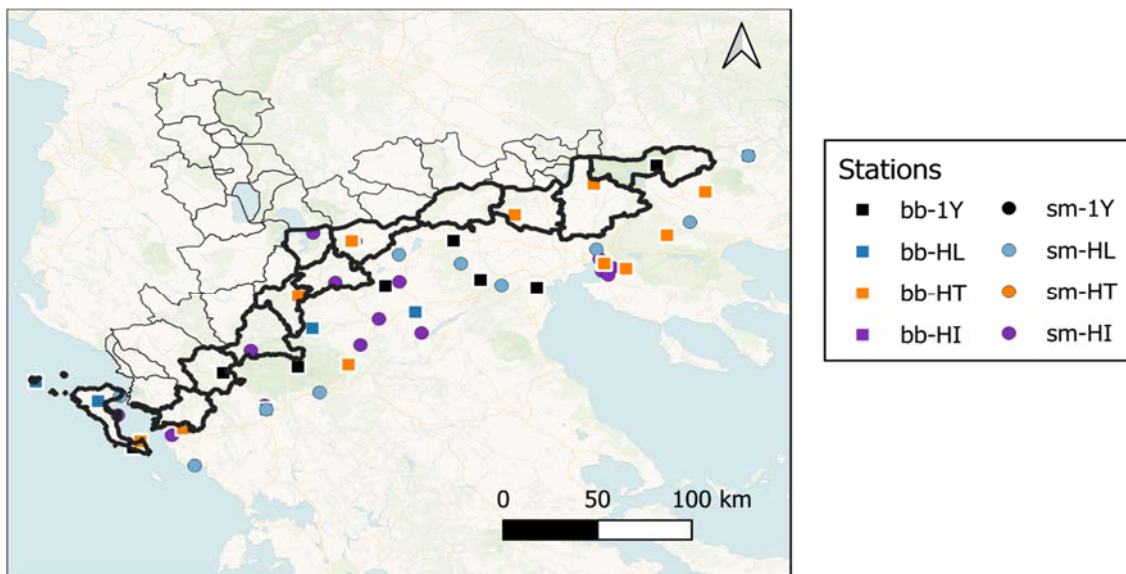
**Figure 1.** All stations colour-coded by network, broadband (bb) and strong-motion (sm), available in Greece via EIDA@NOA.

**Table 1.** Greek stations connected to EIDA@NOA

Network	Channel	Number of stations
HL	HH	99
<b>HL</b>	<b>HN*</b>	<b>97</b>
HP	HH	26
<b>HP</b>	<b>HN*</b>	<b>19</b>
HT	HH	66
HA	HH	37
HC	HH	23
<b>HI</b>	<b>HN*</b>	<b>121</b>
1Y	HH	34

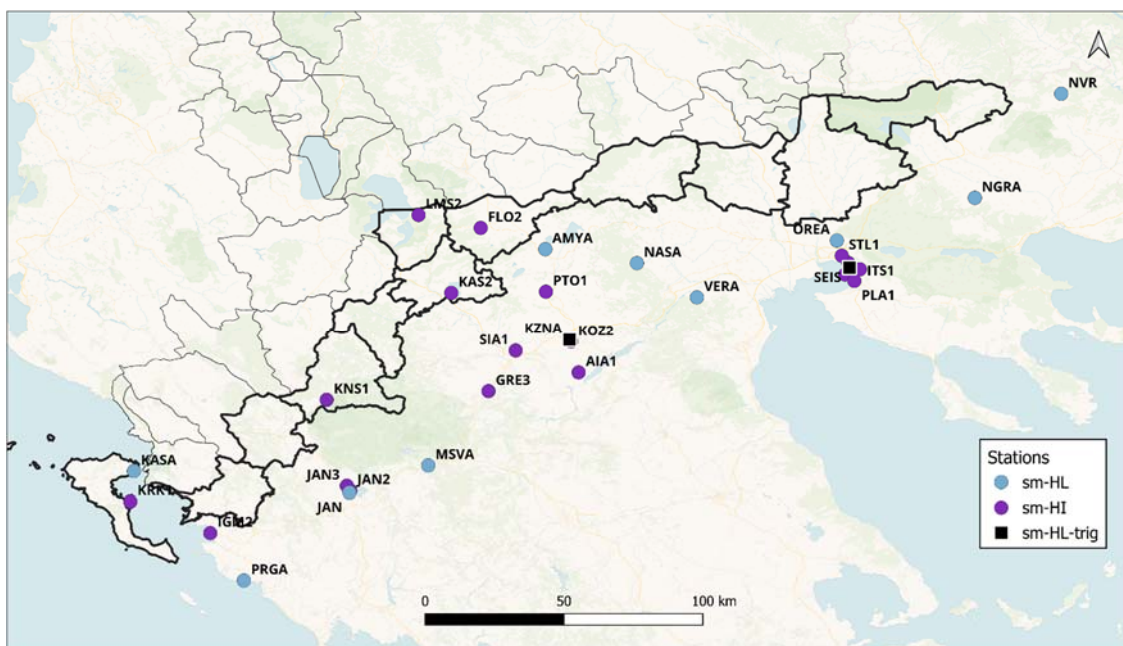
**2.1.2. Stations in area of interest: sensor and accessibility documentation**

The networks of interest for this report are the ones with stations located in the vicinity of the CBR, namely HL, HT, HI and 1Y. We selected a region of interest that includes not only the municipalities in the CBR per se, but also an area roughly 50 km from the borders of those municipalities. This leads to 55 stations, as shown in Figure 2.



**Figure 2.** All stations color-coded by network, broadband (BB) and strong-motion (SM), within the municipalities of the CBR and within about 50 km from their borders.

Out of these networks, the stations of interest are the strong-motion ones, namely coming from HL and HI networks (HN channels). Almost all sensors are of the CMG-5TDE model (<https://www.guralp.com/documents/DAS-050-0006.pdf>), usually connected to a CMG-DM24 model digitizer (<https://www.guralp.com/documents/DAS-D24-0004.pdf>) with 3 channels in case of stand-alone stations and 6 channels in case of collocated stations. These 30 stations are shown in **Figure 3**.



**Figure 3.** Strong-motion stations, color-coded by network, within the municipalities of the CBR and within about 50 km from their borders – triggering-mode stations indicated separately

**Table 2** shows the main information of the 30 stations overall located in the vicinity of CBR, including: network/station/location/channel codes, name of town and specific site of installation, type of structure if known, and coordinates and elevation.

**Table 3** shows more specific information on sensors and data accessibility, such as orientation, sensor description, units, sampling rate/time step, date that the latest epoch started, availability via EIDA@NOA node and public accessibility, status check of each sensor performed for the purpose of this report on 11/1/2026, and link that can be used for real-time health monitoring.

Note that HL stand-alone stations sample at 200 Hz, allowing the user to better capture high frequencies. The 3 collocated HL stations (NVR, KZN, JAN) and all HI stations sample at 100 Hz, not allowing usable signal content above 40 Hz due to the anti-alias effect near the Nyquist.

**Table 2.** Stations in the CBR – main information

Number	Network code	Station code	Location code	Channel code	Location	Site	Building	Latitude	Longitude	Elevation [m]
1	HL	AMYA	00	HN	AMYNTAIO	Town Hall	5-storey RC	40.6901	21.67899	595
2	HL	JAN	00	HN	IOANNINA	Seismic Station JAN	1-storey RC	39.65616	20.84874	526
3	HL	KASA	00	HN	KASSIOPI	Town Hall	2-storey RC	39.74628	19.93542	65
4	HL	KZNA	n/a	HN	KOZANI	Seismic Station KZN	1-storey RC	40.30331	21.78209	791
5	HL	MSVA	00	HN	METSOVO	Town Hall	3-storey masonry	39.7704	21.1828	1157
6	HL	NASA	00	HN	NAOUSSA	Town Hall	3-storey RC	40.63111	22.06706	350
7	HL	NGRA	00	HN	NIGRITA	Town Hall	3-storey RC	40.90747	23.49933	68
8	HL	NVR	00	HN	KATO NEVROKOPI	Seismic Station NVR	1-storey RC	41.34846	23.86517	627
9	HL	OREA	00	HN	ORAIOKASTRO	Town Hall	2-storey RC	40.72705	22.91452	257
10	HL	PRGA	00	HN	PARGA	Town Hall	2-storey RC	39.28557	20.40157	15
11	HL	THEB	n/a	HN	THESSALONIKI	OTE Toumba	2-storey RC	40.6123	22.9677	42
12	HL	VERA	00	HN	VERGINA	Town Hall	2-storey RC	40.48601	22.32151	117
13	HI	AIA1		HN	Aiani	Old town hall	-	40.1641	21.8202	448
14	HI	FLO2		HN	Florina	KEP	-	40.7801	21.4052	664
15	HI	GRE3		HN	Grevena	Prefecture	-	40.08481	21.43829	517
16	HI	IGM2		HN	Igoumenitsa	harbor	-	39.486153	20.259241	4
17	HI	ITS1		HN	Pylaia	ITSAK	-	40.605	23.0123	173
18	HI	JAN2		HN	Ioannina	Prefecture	-	39.664	20.85222	503
19	HI	JAN3		HN	Ioannina	Municipality technical service	-	39.684	20.8379	481

20	HI	KAS2		HN	Kastoria	hospital	-	40.504878	21.280507	644
21	HI	KLR1		HN	Kalamaria	Town Hall	-	40.58251	22.949554	28
22	HI	KNS1		HN	Konitsa	Town Hall	-	40.048	20.7524	621
23	HI	KOZ2		HN	Kozani	Prefecture	-	40.295728	21.788123	731
24	HI	KRK1		HN	Corfu	Prefecture	-	39.618861	19.9202	10
25	HI	LMS2		HN	Laimos	Town Hall	-	40.834985	21.141815	923
26	HI	PLA1		HN	Pylaia	Cosmos office	-	40.555907	22.988593	13
27	HI	PTO1		HN	Ptolemaida	Town Hall	-	40.510132	21.681568	603
28	HI	SEIS		HN	Thessaloniki	Seismological station	-	40.631849	22.962768	63
29	HI	SIA1		HN	Siatista	KEP	-	40.257308	21.553432	918
30	HI	STL1		HN	Stavroupoli	Town Hall	-	40.662419	22.935323	28

**Table 3.** Stations in the CBR – sensor, operation, and data accessibility information

No.	Network code	Station code	Azimuth of E channel	Sensor Description	Scale Units	Sampling rate [Hz]	Time step [s]	Epoch start	Publicly accessible via EIDA@NOA	status check 11/01/2026	Webpage for real-time health monitoring
1	HL	AMYA	90	CMG-5TDE	M/S**2	200	0.005	12/5/2011	yes	offline	<a href="https://accelnet.gein.noa.gr/plots/AMYA.html">https://accelnet.gein.noa.gr/plots/AMYA.html</a>
2	HL	JAN	90	CMG-5TDE	M/S**2	200	0.005	2/15/2011	yes	ok	<a href="https://accelnet.gein.noa.gr/plots/JANA.html">https://accelnet.gein.noa.gr/plots/JANA.html</a>
3	HL	KASA	45	CMG-5TDE	M/S**2	200	0.005	12/8/2010	yes	offline	<a href="https://accelnet.gein.noa.gr/plots/KASA.html">https://accelnet.gein.noa.gr/plots/KASA.html</a>
4	HL	KZNA	n/a	A900	M/S**2	200	0.005	n/a	no	ok (manual check with operator)	n/a
5	HL	MSVA	290	CMG-5TDE	M/S**2	200	0.005	11/19/2020	yes	ok	<a href="https://accelnet.gein.noa.gr/plots/MSVA.html">https://accelnet.gein.noa.gr/plots/MSVA.html</a>
6	HL	NASA	105	CMG-5TDE	M/S**2	200	0.005	9/6/2011	yes	ok	<a href="https://accelnet.gein.noa.gr/plots/NASA.html">https://accelnet.gein.noa.gr/plots/NASA.html</a>
7	HL	NGRA	100	CMG-5TDE	M/S**2	200	0.005	9/7/2011	yes	ok	<a href="https://accelnet.gein.noa.gr/plots/NGRA.html">https://accelnet.gein.noa.gr/plots/NGRA.html</a>
8	HL	NVR	90	CMG-5TDE	M/S**2	200	0.005	10/23/2024	yes	ok	<a href="https://accelnet.gein.noa.gr/plots/NVR.html">https://accelnet.gein.noa.gr/plots/NVR.html</a>
9	HL	OREA	40	CMG-5TDE	M/S**2	200	0.005	9/8/2011	yes	ok	<a href="https://accelnet.gein.noa.gr/plots/OREA.html">https://accelnet.gein.noa.gr/plots/OREA.html</a>
10	HL	PRGA	330	CMG-5TDE	M/S**2	200	0.005	7/14/2012	yes	ok	<a href="https://accelnet.gein.noa.gr/plots/PRGA.html">https://accelnet.gein.noa.gr/plots/PRGA.html</a>
11	HL	THEB	n/a	QDR	M/S**2	100	0.01	n/a	no	no battery (manual check with operator)	n/a
12	HL	VERA	290	CMG-5TDE	M/S**2	200	0.005	3/29/2011	yes	ok	<a href="https://accelnet.gein.noa.gr/plots/VERA.html">https://accelnet.gein.noa.gr/plots/VERA.html</a>
13	HI	AIA1	90	CMG-5TDE	M/S**2	100	0.01	6/1/2016	yes	ok	<a href="http://www.geophysics.geol.uoa.gr/stations/gmaps3/leaf_plotpage.php?net=HI&amp;station=AIA1&amp;lang=en">http://www.geophysics.geol.uoa.gr/stations/gmaps3/leaf_plotpage.php?net=HI&amp;station=AIA1&amp;lang=en</a>
14	HI	FLO2	90	CMG-5TDE	M/S**2	100	0.01	2/1/2013	yes	offline	<a href="http://www.geophysics.geol.uoa.gr/stations/gmaps3/leaf_plotpage.php?net=HI&amp;station=FLO2&amp;lang=en">http://www.geophysics.geol.uoa.gr/stations/gmaps3/leaf_plotpage.php?net=HI&amp;station=FLO2&amp;lang=en</a>
15	HI	GRE3	90	CMG-5TDE	M/S**2	100	0.01	2/1/2013	yes	ok	<a href="http://www.geophysics.geol.uoa.gr/stations/gmaps3/leaf_plotpage.php?net=HI&amp;station=GRE3&amp;lang=en">http://www.geophysics.geol.uoa.gr/stations/gmaps3/leaf_plotpage.php?net=HI&amp;station=GRE3&amp;lang=en</a>

16	HI	IGM2	90	CMG-5TDE	M/S**2	100	0.01	6/15/2016	yes	n/a	<a href="http://www.geophysics.geol.uoa.gr/stations/gmaps3/leaf_plotpage.php?net=HI&amp;station=IGM2&amp;lang=en">http://www.geophysics.geol.uoa.gr/stations/gmaps3/leaf_plotpage.php?net=HI&amp;station=IGM2&amp;lang=en</a>
17	HI	ITS1	90	CMG-5TDE	M/S**2	100	0.01	6/15/2016	yes	ok	<a href="http://www.geophysics.geol.uoa.gr/stations/gmaps3/leaf_plotpage.php?net=HI&amp;station=ITS1&amp;lang=en">http://www.geophysics.geol.uoa.gr/stations/gmaps3/leaf_plotpage.php?net=HI&amp;station=ITS1&amp;lang=en</a>
18	HI	JAN2	90	CMG-5TDE	M/S**2	100	0.01	2/1/2013	yes	ok	<a href="http://www.geophysics.geol.uoa.gr/stations/gmaps3/leaf_plotpage.php?net=HI&amp;station=JAN2&amp;lang=en">http://www.geophysics.geol.uoa.gr/stations/gmaps3/leaf_plotpage.php?net=HI&amp;station=JAN2&amp;lang=en</a>
19	HI	JAN3	90	CMG-5TDE	M/S**2	100	0.01	2/1/2013	yes	ok	<a href="http://www.geophysics.geol.uoa.gr/stations/gmaps3/leaf_plotpage.php?net=HI&amp;station=JAN3&amp;lang=en">http://www.geophysics.geol.uoa.gr/stations/gmaps3/leaf_plotpage.php?net=HI&amp;station=JAN3&amp;lang=en</a>
20	HI	KAS2	90	CMG-5TDE	M/S**2	100	0.01	2/1/2013	yes	ok	<a href="http://www.geophysics.geol.uoa.gr/stations/gmaps3/leaf_plotpage.php?net=HI&amp;station=KAS2&amp;lang=en">http://www.geophysics.geol.uoa.gr/stations/gmaps3/leaf_plotpage.php?net=HI&amp;station=KAS2&amp;lang=en</a>
21	HI	KLR1	90	CMG-5TDE	M/S**2	100	0.01	2/1/2013	yes	ok	<a href="http://www.geophysics.geol.uoa.gr/stations/gmaps3/leaf_plotpage.php?net=HI&amp;station=KLR1&amp;lang=en">http://www.geophysics.geol.uoa.gr/stations/gmaps3/leaf_plotpage.php?net=HI&amp;station=KLR1&amp;lang=en</a>
22	HI	KNS1	90	CMG-5TDE	M/S**2	100	0.01	2/1/2013	yes	ok	<a href="http://www.geophysics.geol.uoa.gr/stations/gmaps3/leaf_plotpage.php?net=HI&amp;station=KNS1&amp;lang=en">http://www.geophysics.geol.uoa.gr/stations/gmaps3/leaf_plotpage.php?net=HI&amp;station=KNS1&amp;lang=en</a>
23	HI	KOZ2	90	CMG-5TDE	M/S**2	100	0.01	2/1/2013	yes	ok	<a href="http://www.geophysics.geol.uoa.gr/stations/gmaps3/leaf_plotpage.php?net=HI&amp;station=KOZ2&amp;lang=en">http://www.geophysics.geol.uoa.gr/stations/gmaps3/leaf_plotpage.php?net=HI&amp;station=KOZ2&amp;lang=en</a>
24	HI	KRK1	90	CMG-5TDE	M/S**2	100	0.01	2/2/2013	yes	offline	<a href="http://www.geophysics.geol.uoa.gr/stations/gmaps3/leaf_plotpage.php?net=HI&amp;station=KRK1&amp;lang=en">http://www.geophysics.geol.uoa.gr/stations/gmaps3/leaf_plotpage.php?net=HI&amp;station=KRK1&amp;lang=en</a>
25	HI	LMS2	90	CMG-5TDE	M/S**2	100	0.01	2/2/2013	yes	ok	<a href="http://www.geophysics.geol.uoa.gr/stations/gmaps3/leaf_plotpage.php?net=HI&amp;station=LMS2&amp;lang=en">http://www.geophysics.geol.uoa.gr/stations/gmaps3/leaf_plotpage.php?net=HI&amp;station=LMS2&amp;lang=en</a>
26	HI	PLA1	90	CMG-5TDE	M/S**2	100	0.01	2/1/2013	yes	ok	<a href="http://www.geophysics.geol.uoa.gr/stations/gmaps3/leaf_plotpage.php?net=HI&amp;station=PLA1&amp;lang=en">http://www.geophysics.geol.uoa.gr/stations/gmaps3/leaf_plotpage.php?net=HI&amp;station=PLA1&amp;lang=en</a>
27	HI	PTO1	90	CMG-5TDE	M/S**2	100	0.01	2/1/2013	yes	ok	<a href="http://www.geophysics.geol.uoa.gr/stations/gmaps3/leaf_plotpage.php?net=HI&amp;station=PTO1&amp;lang=en">http://www.geophysics.geol.uoa.gr/stations/gmaps3/leaf_plotpage.php?net=HI&amp;station=PTO1&amp;lang=en</a>

28	HI	SEIS	90	CMG-5TDE	M/S**2	100	0.01	2/1/2013	yes	ok	<a href="http://www.geophysics.geol.uoa.gr/stations/gmaps3/leaf_plotpage.php?net=HI&amp;station=SEIS&amp;lang=en">http://www.geophysics.geol.uoa.gr/stations/gmaps3/leaf_plotpage.php?net=HI&amp;station=SEIS&amp;lang=en</a>
29	HI	SIA1	90	CMG-5TDE	M/S**2	100	0.01	2/1/2013	yes	ok	<a href="http://www.geophysics.geol.uoa.gr/stations/gmaps3/leaf_plotpage.php?net=HI&amp;station=SIA1&amp;lang=en">http://www.geophysics.geol.uoa.gr/stations/gmaps3/leaf_plotpage.php?net=HI&amp;station=SIA1&amp;lang=en</a>
30	HI	STL1	90	CMG-5TDE	M/S**2	100	0.01	2/1/2013	yes	ok	<a href="http://www.geophysics.geol.uoa.gr/stations/gmaps3/leaf_plotpage.php?net=HI&amp;station=STL1&amp;lang=en">http://www.geophysics.geol.uoa.gr/stations/gmaps3/leaf_plotpage.php?net=HI&amp;station=STL1&amp;lang=en</a>

## 2.2. North Macedonia

The Strong Ground Motion Laboratory at UKIM-IZIIS was established as early as 1972, marking the inception of the Yugoslav Strong Motion Network. This initiative was part of a project funded and supported by USAID, the U.S. National Science Foundation, the Federal Office for International Cultural-Educational, Scientific and Technical Cooperation, as well as the Technical Cooperation Office of the Republic of Macedonia (Mihailov et al., 1975, 1977).

The capacity of the IZIIS Strong Motion Network was significantly enhanced between 2007 and 2015 with the installation of new digital accelerometric stations provided through two NATO Science for Peace and Security projects aimed at harmonizing seismic hazard maps for the Western Balkan countries (NATO SpS-983054 and NATO SpS-984374).

Since its foundation in 1972, the Strong Ground Motion Laboratory at IZIIS has continuously monitored seismic activity across the territory of North Macedonia and the surrounding border regions, providing invaluable data for seismic hazard evaluation and risk mitigations.

The current operational status of the digital accelerometric stations is listed in **Table 4**.

**Table 4.** UKIM-IZIIS National Strong Motion Network

Number	Network code	Station code	Location code	Instrument type	Location	Site	Building	Latitude	Longitude	Elevation [m]
1	MA	KPAL	n/a	CMG-5TD	KRIVA PALANKA	Seismic / Vault		42.12091	22.36306	849
2	MA	LIS	n/a	CMG-5TD	VELES	Building	Ground Floor RC	41.687500	21.59786	429
3	MA	OHR	n/a	CMG-5TD	OHRID	Building	Ground Floor RC	41.11149	20.7899	744
4	MA	PEH	n/a	CMG-5TD	PEHCHEVO	Building	Basement RC	<b>41.776278</b>	<b>22.89772</b>	1114
5	MA	SKI	n/a	ETNA-2	SKOPE	Building	Basement RC	<b>41.98017</b>	<b>21.42538</b>	350
6	MA	PES	n/a	ETNA-2	SKOPE	Building	Basement RC	41.99712	21.42105	127
7	MA	DBR	n/a	CMG-5TD	DEBAR	Building	Ground Floor RC	41.49469	20.49863	520
8	MA	VAL	n/a	CMG-5TD	VALANDOVO	Building	Ground Floor RC	<b>41.32151</b>	<b>22.5645</b>	179
9	MA	GLO	n/a	ETNA-2	GLOBOCHICA	Building	Ground Floor RC	41.33776	20.63599	692
10	MA	ZLT	n/a	CMG-5TD	KNEZHEVO	Building	Ground Floor RC	42.10928	22.30667	1020

### 2.2.2. Data Archiving and Processing

Strong motion data recorded within the UKIM-IZIIS network are stored in either GCF or KMI format, depending on the instrument type. The recorded data are manually processed using the software applications SignalProcessingApp and SignalAnalysis, developed at IZIIS by Prof. Dr. Igor Gjorgjiev.

Two types of strong-motion instruments are currently in use within the network, each employing different recording and transmission protocols:

- **CMG-5TD:** Data transmission is supported through protocols such as GCF (Guralp Compressed Format) or SeedLink. Recorded data are typically stored in GCF, MiniSEED, or ASCII formats. Most sensors transmit data wirelessly and in real time, but in the connection failure, data are buffered internally within the instrument for up to seven days and must be retrieved manually on site.

Conversion from digital counts to physical units ( $\text{m/s}^2$ ) is performed automatically or semi-automatically using calibration constants embedded in software tools such as Scream! or SeisComP. Processed data can be locally archived in TXT or CSV formats, depending on the system configuration and user preferences.

- **ETNA 2:** Data is transmitted using Kinematics protocols or SeedLink, and is typically recorded in MiniSEED or ASCII format. Most sensors transmit data wirelessly and in real time, but in the connection failure, data are buffered internally within the instrument for up to seven days and must be retrieved manually on site. Conversion from digital units (counts) to physical units ( $\text{m/s}^2$ ) is performed automatically or semi-automatically using calibration factors integrated into software tools such as EtnaViewer, Antelope, or SeisComP. The processed data is locally archived in TXT or CSV files, depending on the system configuration.

The initial step in data processing involves visual inspection and quality control of the recordings. Segments exhibiting high noise levels, distortions, spikes, or other artifacts are excluded from storage.

The next step is baseline correction of the accelerograms and application of an appropriate filter for signal processing.

### 2.2.3. Technical Specifications of Equipment

- **Instruments:**
  - **Guralp CMG-5TD**  
Sensor Type: Force-balanced triaxial accelerometer (CMG-5T), Dynamic Range: > 140 dB, Frequency Response: DC to 100 Hz (flat response), Full Scale Range:  $\pm 0.25$  g to  $\pm 4$  g (configurable), Sensitivity: Configurable via internal jumpers, Self-Noise:

Low noise floor suitable for strong motion and structural monitoring, Orientation: Orthogonal axes (X, Y, Z), Temperature Range: -20°C to +70°C, Enclosure: Watertight, ruggedized for field deployment

○ **ETNA-2**

Sensor Type: Internal triaxial EpiSensor (force-balance accelerometer), Full Scale Range:  $\pm 1$  g,  $\pm 2$  g, or  $\pm 4$  g (user-selectable), Frequency Response: DC to 200 Hz, Dynamic Range:  $\sim 130$  dB at 100 sps (RMS clip to RMS noise), 139 dB at 100 sps (peak-to-peak to RMS noise), Offset: Factory set, software re-zeroing available, Orientation: Orthogonal triaxial configuration

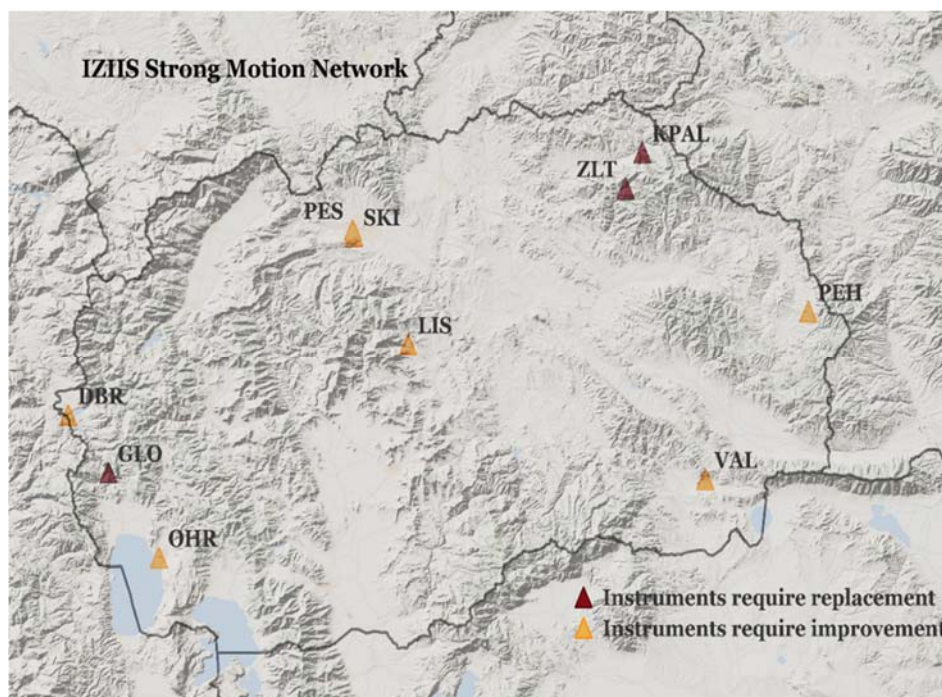
● **Dataloggers:**

○ *Güralp CMG-5TD*: Digitizer: 24-bit resolution (DM-24), Sampling Rates: Selectable from 1 to 500 samples per second, Timing: GPS-synchronized, Data Format: GCF (Güralp Compressed Format), Storage: Internal flash memory, Power Supply: 10–36 V DC, Interfaces: Serial (RS-232), optional Ethernet, Environmental Protection: IP67-rated enclosure

○ *ETNA-2*: Digitizer: 24-bit Delta Sigma ADC, one per channel, Sampling Rates: Multiple, including high-rate for early warning, Timing: Built-in GPS and PTP (Precision Time Protocol), Data Storage: Internal memory + USB mirroring (parallel recording), Communication: Ethernet, USB (Wi-Fi or cellular modem support), Telemetry protocols: ORB, Earthworm, SeedLink, Power Supply: 9–36 V DC, Environmental Protection: IP67 (survives 1 m immersion), Other Features: Streamlined Station Maintenance (SSM), State-of-health monitoring, Secure access via SSH/SSL

#### **2.2.4. Improvement of strong motion network (stations evaluation and online availability)**

In the period between July and November 2025, all instruments' installations at the station locations were evaluated for operability and online data streaming capability. **Figure 4** illustrates the instruments' placement, operational status, and indicates whether improvements are required at each station.



**Figure 4.** Operational status of the instruments following the evaluation. Red indicates locations where the instrument is no longer operational, yellow denotes instruments requiring further improvements for stable connectivity

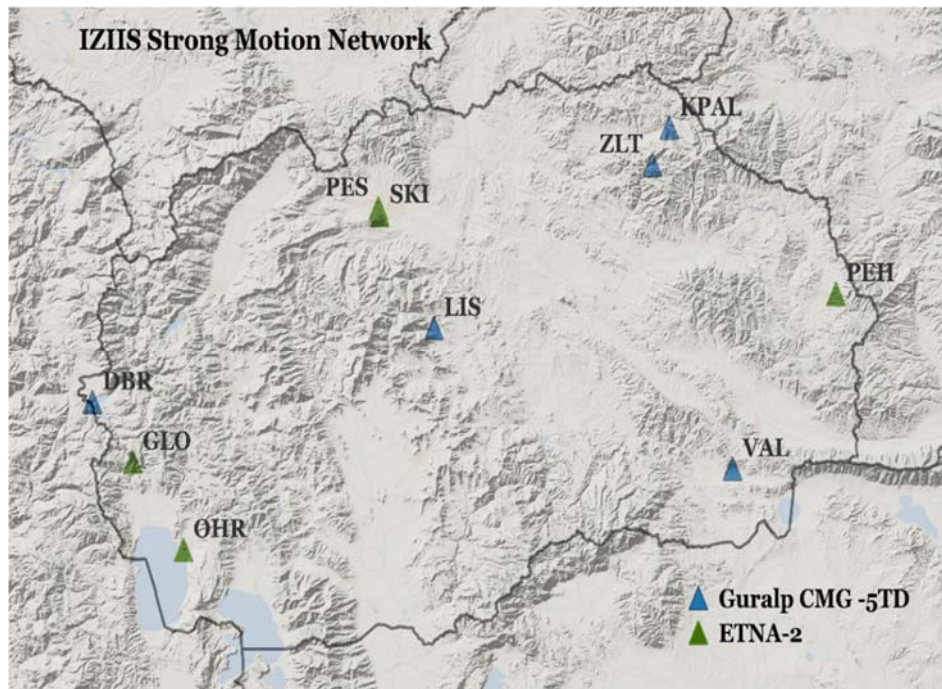
Following the field activities and evaluation of instrument performance, an optimization of the network was carried out through rearrangement and expansion. This included the replacement and upgrading of units, supported through the institute's contribution.

Based on the field activities, the current status of each station is as follows:

- **OHR station** - The instrument is operating correctly. However, to enable network connectivity, the router must be replaced with one that supports the necessary configuration settings. Additionally, an RS232/LAN converter – SOLLAE CSE-H53N needs to be procured. The converter is mounted.
- This seismological station location was upgraded with ETNA-2 instrument, Güralp CMG-5TD was temporarily installed at a different site (KPAL) because the instrument at that location was out of service.
- **DBR station** - The instrument is operating correctly. However, to enable network connectivity, the router must be replaced with one that supports the necessary configuration settings. Additionally, an RS232/LAN converter – SOLLAE CSE-H53N needs to be procured. Additional instrument calibration is needed.
- **LIS station** - The instrument was operating correctly. The instrument's parameters can only be changed through direct access; it does not allow remote configuration over an internet connection.
- **SKI station** - The instrument is operating correctly. However, to enable network connectivity, the router must be replaced with one that supports the necessary configuration settings. Additionally, an RS232/LAN converter – SOLLAE CSE-H53N needs to be procured.

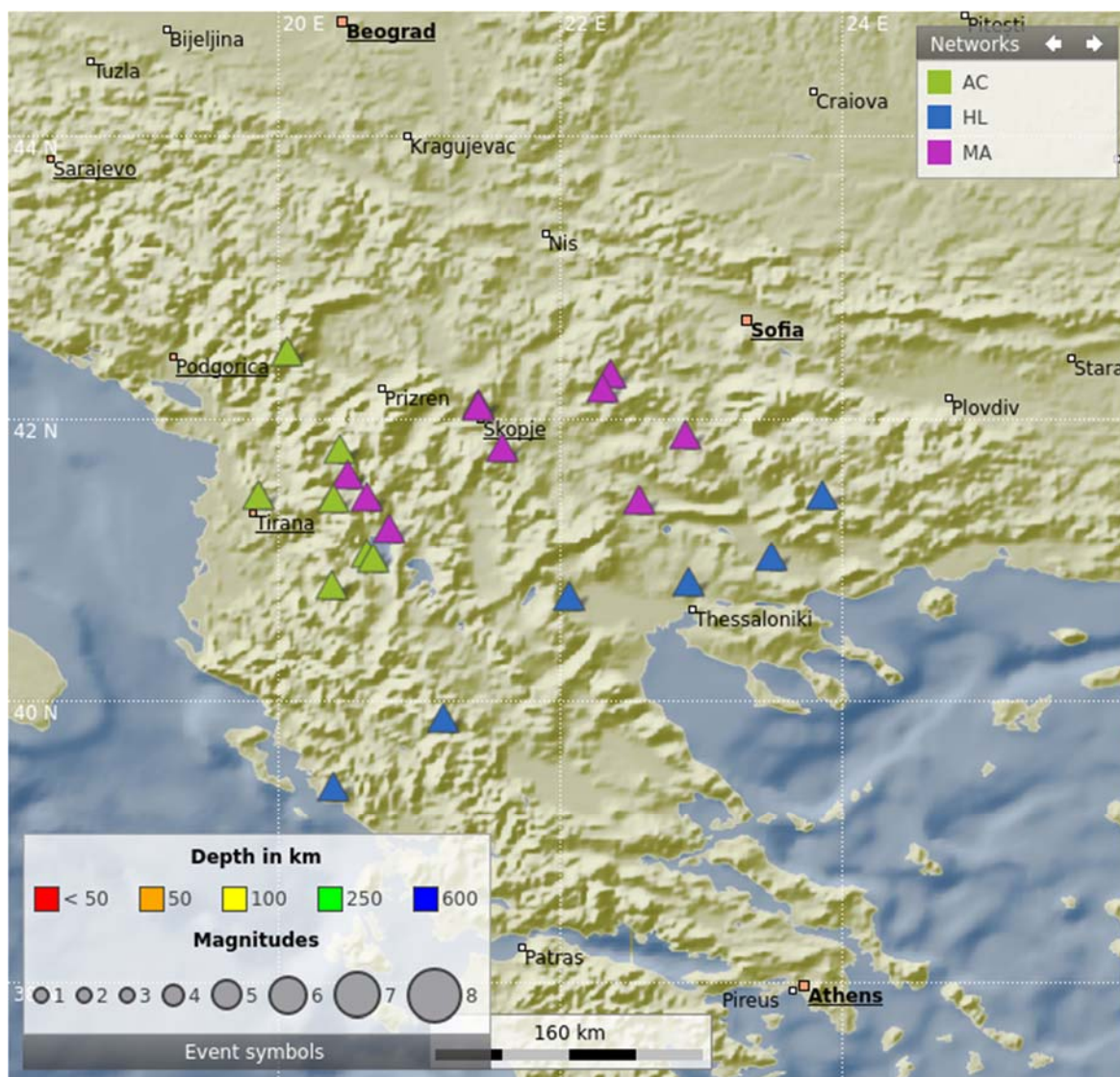
- **KPAL station** – The instrument is not operating correctly. Online connection is currently unavailable, and the unit has been dismantled for servicing. The instrument is not responding, so a new one is required. Consequently, it was replaced with another Güralp CMG-5TD unit relocated from the OHR station.
- **PEH station** - The instrument is operating correctly. Additional Instrument calibration has been performed.
- This seismological station location was upgraded with ETNA-2 instrument, Güralp CMG-5TD was temporarily installed at a different site (ZLT) because the instrument at that location was out of service.
- **VAL station** - The instrument is operating correctly. Additional Instrument calibration has been performed.
- **ZLT station** - The instrument was operating correctly. Additional Instrument calibration has been performed. Meanwhile, the instrument is not responding, so a new one is required. Consequently, it was replaced with another Güralp CMG-5TD unit relocated from the PEH station.
- **GLO station** – An ETNA-2 instrument (serial number 105663) is installed at the location. Access requires the gate to be open.
- **PES station** - An ETNA-2 instrument (serial number 104506) is installed at the location. Access requires the gate to be open.

Figure 5 presents the current operational status of the instruments after improvement.



**Figure 5.** Operational status of the instruments and instrument types after implementing improvements based on the evaluation notes and identified shortcomings

The UKIM-IZIIS Strong Motion Network supports seismic monitoring, structural engineering assessments, and rapid earthquake response. The network is currently undergoing integration with ORFEUS-EIDA, aiming to enable near real-time seismic data transmission and enhance data accessibility. As part of this integration, instruments are being progressively connected to a SeisComP adopted server, allowing for near real-time data observation and monitoring (Figure 6).



**Figure 6.** Operational status of the instruments connected to a SeisComP adopted server

Future development plans include upgrading the network by replacing existing instruments with modern, up-to-date sensors, and expanding coverage through the installation of additional strong-motion recording stations at new locations.

## 2.3. Albania

The Albanian Strong Motion Network (ASMN) was fully established in 2015 as part of the NATO "Science for Peace and Security" project. Its primary objective is to provide seismic acceleration recordings in key urban centers across Albania, both during strong earthquakes and on a permanent, continuous basis. The network plays a vital role in supporting seismic hazard assessment and earthquake engineering applications, making a significant contribution to seismic risk evaluation and mitigation efforts.

The initial phase of deployment focused on installing accelerometric stations in several major cities, equipped with high-quality sensors and dataloggers. The current operational status of these stations is listed in Table 5.

The Albanian Strong Motion Network has recently been significantly improved and expanded, enhancing its capacity to record and transmit seismic accelerations in real time with broader national coverage. This advancement was made possible through the installation of ten additional short-period (SP) and strong-motion (HN) stations, each equipped with six-channel dataloggers and two types of high frequency sensors, specifically designed for reliable real-time monitoring (Table 5). These new stations have considerably increased the network density, improved spatial resolution, and strengthened the ability to capture strong ground motions across the country.

This expansion, supported by the Resilience Strengthening in Albania (RESEAL) initiative, also facilitated the modernization of seismic data acquisition systems and the upgrade of the monitoring infrastructure, contributing to a more robust and responsive network. As a result, Albania now benefits from an enhanced capacity for seismic hazard assessment, earthquake engineering applications, and rapid emergency response.

### 2.3.1. Data Transmission and Archiving Technology

- CMG-5TD sensors: Transmit data via Scream! server and are recorded in GCF format. Data is automatically converted to MiniSEED using SeisComP and archived in SDS structure.
- Trident sensors: Transmit real-time data via Nanometrics SeedLink server.
- SA10 sensors with SL06 dataloggers: Operate with SeedLink protocol and are fully compatible with modern real-time seismic networks.

**Table 5.** The Albanian National Strong Motion Network (ASMN)

Nu mb er	Netw ork code	Statio n code	Locatio n code	Chan nel code	Locati on	Site	Building	Latitude	Longitude	Elevation [m]	INGV station link
1	AC	BCI	01	HN	BCI	Ground + pillar	small 1 store	42.36353	20.07236	393	<a href="https://www.eida.ingv.it/en/station/AC/BCI">https://www.eida.ingv.it/en/station/AC/BCI</a>
2	AC	BELS	01	HN	BELS	Ground + pillar	sandwich hut	40.970887	19.91284	243	
3	AC	BERA	01	HN	BERA	Ground + pillar	free field	40.708114	19.945508	234.38	<a href="https://www.eida.ingv.it/en/station/AC/BERA">https://www.eida.ingv.it/en/station/AC/BERA</a>
4	AC	BURR	01	HN	BURR	Ground + pillar	sandwich hut	41.601518	20.004788	362.3	
5	AC	DRSH	01	HN	DRSH	Ground + pillar	sandwich hut	41.281284	19.521452	101.2	
6	AC	DURR	01	HN	DURR	Ground + pillar	free field	41.3198695	19.457375	13.8	
7	AC	ELBA	01	HN	ELBA	Ground + pillar	3-story building/basement	41.11618478	20.0798024	148.39	
8	AC	FIER	01	HN	FIER	Ground + pillar	2-story building/basement	40.7174188	19.5669194	22.7	
9	AC	FUST	01	HN	FUST	Ground + pillar	sandwich hut	41.325147	20.396955	1161	
10	AC	HIMA	01	HN	HIMA	Ground + pillar	2-story building/basement	40.088996	19.75818	129	
11	AC	KBN	01	HN	KBN	Ground + pillar	2-story building/basement	40.623069	20.785911	892.4	<a href="https://www.eida.ingv.it/en/station/AC/KBN">https://www.eida.ingv.it/en/station/AC/KBN</a>
12	AC	KKS	01	HN	KKS	ground + pillar	small 1 store	42.0730664	19.4963537	356.2	
13	AC	LACI	01	HN	LACI	Ground + pillar	3-story building/basement	41.63668234	19.7178092	55.69	<a href="https://www.eida.ingv.it/en/station/AC/LACI">https://www.eida.ingv.it/en/station/AC/LACI</a>
14	AC	MOGL	01	HN	MOGL	Ground + pillar	sandwich hut	40.705413	20.391577	496.7	
15	AC	PHP	01	HN	PHP	Ground + pillar	small 1 store	41.6847	20.4408	670	<a href="https://www.eida.ingv.it/en/station/AC/PHP">https://www.eida.ingv.it/en/station/AC/PHP</a>
16	AC	PLSA	01	HN	PLSA	Ground + pillar	sandwich hut	40.165902	19.623978	385.6	
17	AC	POGR	01	HN	POGR	Ground + pillar	free field	40.89961	20.679025	739.4	
18	AC	POGR 2	01	HN	POGR 2	Ground + pillar	sandwich hut	40.937615	20.634013	746.7	
19	AC	PRMT	01	HN	PRMT	Ground + pillar	sandwich hut	40.22869	20.351497	294	
20	AC	RZM	01	HN	RZM	Ground + pillar	sandwich hut	42.346311	19.548644	1168	
21	AC	SDA	01	HN	SDA	Ground + pillar	small 1 store	42.050572	19.496385	30.4	<a href="https://www.eida.ingv.it/en/station/AC/SDA">https://www.eida.ingv.it/en/station/AC/SDA</a>
22	AC	SRN	01	HN	SRN	Ground + pillar	2-story building/basement	39.88	20.005	20	<a href="https://www.eida.ingv.it/en/station/AC/SRN">https://www.eida.ingv.it/en/station/AC/SRN</a>

23	MN	TIR	01	HN	TIR	ground + pillar	small 1 store	41.3472	19.8631	247	<a href="https://www.eida.ingv.it/en/station/MN/TIR">https://www.eida.ingv.it/en/station/MN/TIR</a>
24	AC	TIR1	01	HN	TIR1	ground + pillar	small 1 store	41.3351	19.8064	105	
25	AC	TPE	01	HN	TPE	Ground + pillar	2-story building/basement	40.294813	20.015581	253.9	<a href="https://www.eida.ingv.it/en/station/AC/TPE">https://www.eida.ingv.it/en/station/AC/TPE</a>
26	AC	VLO		HN	VLO	Ground + pillar	2-story building/basement	40.470024	19.495082	50	<a href="https://www.eida.ingv.it/en/station/AC/VLO">https://www.eida.ingv.it/en/station/AC/VLO</a>
27	AC	VLO2	01	HN	VLO2	Ground + pillar	sandwich hut	40.46777	19.587592	183	

### 2.3.2. Data Archiving and Processing

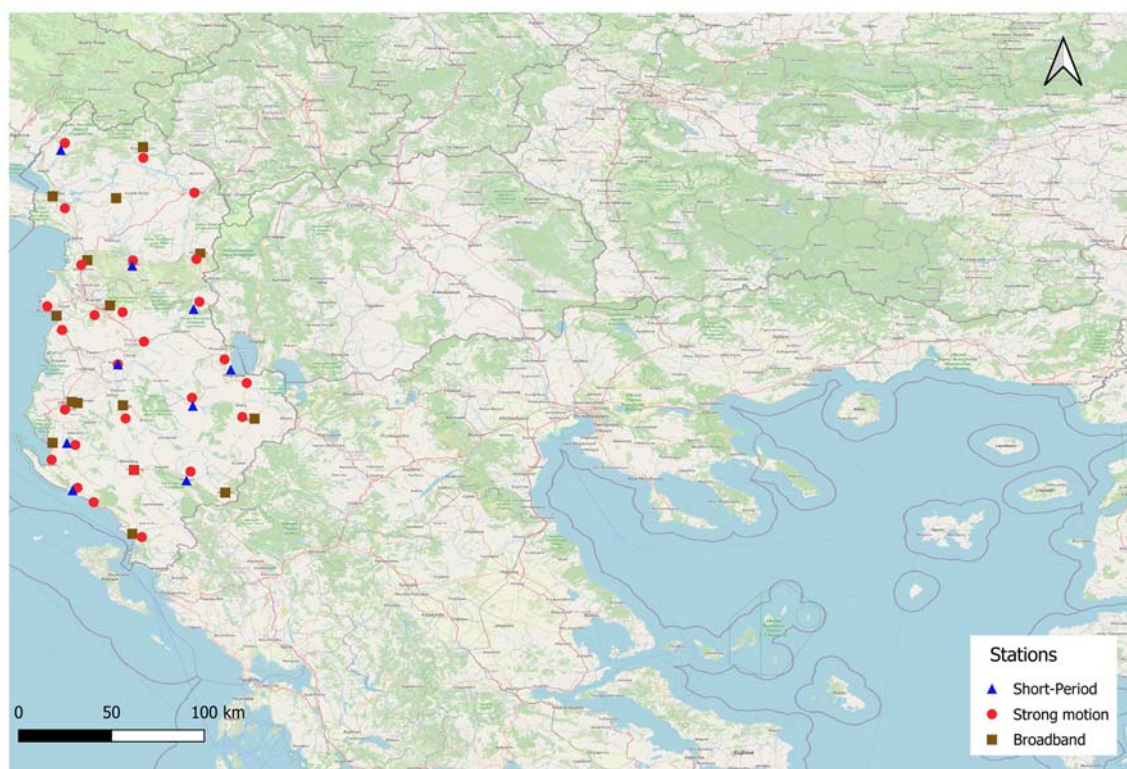
- Until 2022, data were primarily stored in GCF format on an event basis.
- Since the transition to SeisComP in 2023, continuous MiniSEED archiving has been implemented.
- SEISAN is used for event localization, and the system is fully integrated to link accelerometric data for engineering analyses automatically.

### 2.3.3. Technical Specifications of Equipment

- **Sensors:**
  - *CMG-5T / CMG-5TD (Güralp)*: 0.03–100 Hz frequency band, ±4g dynamic range, 24-bit resolution.
  - *SA10 (SARA)*: 0.1–150 Hz frequency band, ±4g dynamic range, 24-bit resolution.
  - *Titan (Nanometrics)*: 0–430 Hz frequency band, ±3g dynamic range, direct SeedLink output.
- **Dataloggers:**
  - *Minimus (Güralp)*: Supports 3 to 6 channels, SeedLink, HTTP, GCF protocols.
  - *SL06 (SARA)*: 6 channels, SeedLink, FTP, syslog protocols.
  - *Trident (Nanometrics)*: 24-bit resolution, real-time SeedLink transmission, integrated Cygnus transceiver.

The Albanian Strong Motion Network currently operates with a combination of permanent and short-period stations, offering broad geographical coverage and real-time seismic data transmission capabilities. The network supports seismic monitoring, engineering analyses, and rapid earthquake response. Recent technological upgrades, including the adoption of SeisComP and the expansion of the RESEAL project, have significantly improved the operational capacity and data availability of the network. Future plans include maintenance and potential densification to further enhance seismic resilience and hazard assessment in Albania.

The distribution of the accelerometric stations of various instrumentation (ASMN), operated by the Department of Seismology, Institute of Geosciences of the Polytechnic University of Tirana, is shown in Figure 7.



**Figure 7.** The distribution of the accelerometric stations of various instrumentation (ASMN), operated by the Department of Seismology, Institute of Geosciences of the Polytechnic University of Tirana

### 3. Integration of CBR Strong Motion Monitoring Capacities

#### 3.1. Greece

##### 3.1.1. Data center and availability

Since 2016, NOA hosts the regional node of EIDA (EIDA@NOA; <https://eida.gein.noa.gr/>; Evangelidis et al., 2021) distributing data from seismic stations located in Greece and the southeastern Mediterranean. EIDA stands for the European Integrated Data Archive (<https://www.orfeus-eu.org/data/eida/>), is run by ORFEUS (<https://www.orfeus-eu.org/>) and is a federated European data center that archives and provides access to seismic data from European research infrastructures. Such data includes waveforms (raw, i.e. unprocessed, not in physical units and not ready for use in engineering applications) and their metadata including station inventory, and quality parameters. Use of these data requires specialised seismological training to produce data series in physical units (e.g. acceleration for HN channels mentioned above) and then make the necessary corrections and processing tailored to use in cascading applications.

The networks currently hosted by EIDA@NOA are the following and include both national networks and specialized/local arrays, in both permanent and temporary layouts :

- HL (NOA, Hellenic Seismic Network), DOI:10.7914/SN/HL
- HT (Aristotle University of Thessaloniki Seismological Network), DOI:10.7914/SN/HT
- HP (University of Patras, Seismological Laboratory), DOI:10.7914/SN/HP
- HA (National and Kapodistrian University of Athens, Seismological Laboratory), DOI:10.7914/SN/HA
- HI (Institute of Engineering Seismology and Earthquake Engineering), DOI:10.7914/SN/HI
- HC (TEI of Crete, Seismological Network of Crete), DOI:10.7914/SN/HC
- CQ (GSD of Cyprus, Cyprus Broadband Seismological Network), DOI:10.7914/SN/CQ
- EG (SDGEE AUTH, EUROSEISTEST Strong Motion Network), DOI:10.7914/SN/EG
- KF (ARGONET), DOI:10.7914/3my7-3148
- ME (Montenegro Seismological Observatory, Montenegrin Seismic Network), DOI:10.7914/SN/ME
- MK (Seismological network of the Republic of North Macedonia, DOI:/10.7914/v6tz-xh04
- MA (Institute of Earthquake Engineering and Engineering Seismology, University "Ss.Cyril and Methodious", UKIM-IZIIS Skopje, R.N.Macedonia), DOI:/10.7914/g4hj-4553
- 1Y (2022-2026) (Greece/North Macedonia Contribution to AdriaArray Temporary Network)
- 5B (2023-2027) (RUB Observational Geophysics Lab Deployment: Northwestern Peloponnese (Pelops)
- 5S (2019-2022) (Icelandic Strong-motion Arrays (ICEARRAY)), DOI:10.7914/SN/5S\_2019
- X5 (2015-2016) (LF - Lefkada temporary network), DOI:10.7914/SN/X5\_2015
- YB (2007-2007) Trichonis Lake network, DOI:10.7914/SN/YB\_2007
- \_NFOCRL (Near Fault Observatory of Corinth Rift - virtual network)
- \_HUSN (Hellenic Unified Seismic Network - virtual network)

On the other hand, data available in raw format through EIDA are subsequently and routinely processed and distributed in ready-to-use formats -such as windowed and filtered acceleration time series- by ESM (Luzi et al., 2016; Lanzano et al., 2021) and RRSM (Cauzzi et al., 2016), the two strong-motion services run by ORFEUS (<https://www.orfeus-eu.org/data/strong/>). All ORFEUS products follow FAIR principles (Findable, Accessible, Interoperable, Reusable).

Considering **Table 2** above, all Greek accelerometric (HN channel) stations shown for the CBR area except 2 send data via the SeismComp protocol which are then available

via the EIDA@NOA node. Their waveform data is freely accessible and fully compliant with FAIR principles. The exceptions are 2 triggering-mode stations: THEB is a QDR, KZNA is a A900, and both marked in bold in the tables. The former is currently not operating due to battery issues and pending check and replacement, in all probability in the coming months. However, replacing these 2 triggering-mode sensors with digital ones -that can transmit data continuously and not only in the event of strong shaking-, thus enabling connection to EIDA@NOA requires significant budget unrelated to the EMERGE project, which must be arranged internally when possible. Due to the recent Amorgos-Santorini crisis during 2025, these stations have not been the highest priority for the Institute. In fall 2025, all stations were assessed for operability and online data streaming capability. This ad-hoc check revealed that out of the 27 continuous-mode digital stations, 2 from each network were offline (and are currently at the time of writing: AMYA and KASA from HL, and KRK1 and FLO2 from HI), indicated again in bold. An inspection will be attempted in the coming months for AMYA, as it is on the mainland, although KASA is more challenging to reach as it is located on an island. THEB was inspected in February 2026, and it was found it needs repair, which was not possible at this time.

### **3.1.2. Station characterisation parameters**

In the framework of this WP, it is important in addition to waveform accessibility to also gather station metadata as complete as possible for the stations of interest in the CBR. This means not only standard meta parameters such as coordinates, elevation, sampling rate, sensor types etc., but also site characterisation information. In Ktenidou et al. (2024) and Papageorgiou et al. (2025), systematic efforts were made to compile exhaustive information on station characterisation and site response from various points of view, including: geological age and unit description, topography and slope, site amplification, station installation and housing. All these parameters were used to reach a holistic assessment about whether each station can be used to provide reference ground motions or not. For the appropriate use of strong-motion data, especially as many stations are installed in sediments that tend to amplify ground motion, it is deemed important to understand reference potential. Following along those lines, a study was made here to retrieve metadata from all available sources of information, including Ktenidou et al. (2024), Grendas et al. (2018), Margaris et al. (2021), Pilz et al. (2020), the webpages of the network operators, etc.

**Table 6.** Stations in the CBR – site and station characterisation information (part 1)

Number	Network code	Station code	accelnet.gein.noa.g	Margaris et al. (2021)					Piltz et al. (2020)
			Geologic description	Geologic description	Geologic Age	Slope from 3 arc-sec	Slope (degrees)	Preferred $V_{S30}$ for analysis (m/s)	Geology from EGD
1	HL	AMYA	-	Holocene	Alluvial deposits	0.054	3	362	-
2	HL	JAN	limestone	Alluvial deposits	Upper Jurassic - Lower Cretaceous	0.056	3	464	-
3	HL	KASA	Vigla limestone	Alluvial deposits	Upper Jurassic	0.321	18	529	limestone
4	HL	KZNA	limestone	Alluvial deposits	Cretaceous (Turonien-Maestrichtien)	0.113	6	529	sandstone
5	HL	MSVA	flysch	-	-	-	-	-	-
6	HL	NASA	-	Pliocene-Pleistocene	Travertine	0.030	2	420	-
7	HL	NGRA	-	Pleistocene	Terrace	0.017	1	410	-
8	HL	NVR	sandstone	Scree and Talus Cones	Pleistocene	0.258	15	514	-
9	HL	OREA	-	Upper Miocene - Lower Pliocene	Sandstone-Marl Series sandstones friable to quite compact	0.035	2	472	-
10	HL	PRGA	alluvial deposits	Quaternary	fluvial alluvial deposits	0.091	5	496	-
11	HL	THEB	Neogene sandstones, locally marls	-	-	-	-	-	-
12	HL	VERA	alluvial deposits	Pleistocene	Terrace	0.043	2	446	-
13	HI	AIA1	-	Pleistocene-Pliocene	Alluvial deposits	0.064	4	450	-
14	HI	FLO2	-	Neogene	Alluvial deposits	0.051	3	484	-
15	HI	GRE3	-	Quaternary	Alluvial deposits	0.026	2	489	-
16	HI	IGM2	-	Quaternary	Alluvial deposits	0.152	9	455	-
17	HI	ITS1	-						-
18	HI	JAN2	-	QUATERNARY	Alluvial deposits	0.119	7	508	-
19	HI	JAN3	-	QUATERNARY	Alluvial deposits	0.041	2	370	-

20	HI	KAS2	-	Middle - Upper Lias	Alluvial deposits	0.17 2	10	553	-
21	HI	KLR1	-	Upper Miocene - Lower Pleistocene	Alluvial deposits	0.03 5	2	436	-
22	HI	KNS1	-	Pleistocene	Alluvial deposits	0.12 0	7	547	-
23	HI	KOZ2	-	Lower to Upper Pliocene	Alluvial deposits	0.08 1	5	421	-
24	HI	KRK1	-	Quaternary	Alluvial deposits	0.04 1	2	411	-
25	HI	LMS2	-	Holocene	Alluvial deposits	0.05 0	3	428	-
26	HI	PLA1	-	Upper Miocene - Lower Pleistocene	Sandstone-marl series sandstones friable to quite compact, locally microconglomerate s with cross- bending are interbedded. At places there are marl horizons.	0.01 7	1	350	-
27	HI	PTO1	-	Holocene	Recent alluvial deposits IGME- Ptolemais Sheet (al)	0.03	2	406	-
28	HI	SEIS	-	Mesozoic	Leucocratic albite- sericite-microcline gneiss IGME- Thessaloniki Sheet (sch.gn)	0.14 8	9	529	-
29	HI	SIA1	-	Miocene (Upper Aquitanian- Tortonian)	Tsotilion Series consisting of alternating conglomerates, sandstones and marls.	0.15 0	9	508	-
30	HI	STL1	-	Upper Miocene - Lower Pleistocene	Sandstone-marl series sandstones friable to quite compact, locally microconglomerate s with cross- bending are interbedded. At places there are marl horizons.	0.05 3	3	388	-

**Table 7.** Stations in the CBR – site and station characterisation information (part 2)

Number	Network code	Station code	Ktenidou et al. (2024)						Grendas et al. (2018)
			Geologic unit	Geologic age	Reference used - HSGME map sheet	Topographic slope	HVSR - potential reference site?	Installation	HVSR - potential reference site?
1	HL	AMYA	-	-	-	-	-	-	-
2	HL	JAN	Old alluvian with fragments of silex from Vigla limestones and Doggerian sediments	Quaternary	Ioannina Sheet	Flat/shallow (<15) within 200 m	Small broadband amplification	vault in building	-
3	HL	KASA	Limestones of Vigla	upper Jurassic (Tithonion) - upper Cretaceous	North Korfou Sheet	Steep (<30) within 200 m	Reference station	not free field	-
4	HL	KZNA	Pelagonian Zone (Formations of Kozani channel): calcareous material from transgression	Middle-Upper Cretaceous	Kozani Sheet	Flat/shallow (<15) within 200 m	Small broadband amplification	vault in building	-
5	HL	MSVA	-	-	-	-	-	-	-
6	HL	NASA	-	-	-	-	-	-	-
7	HL	NGRA	-	-	-	-	-	-	-
8	HL	NVR	Metamorphic rocks/upper series (schists, schist-gneisses, gneisses, amphibolites and marbles)	Oligocene - Miocene	Kato Nevrokopion Sheet	Flat/shallow (<15) within 200 m	Small HF amplification (7 Hz)	free field	-
9	HL	OREA	-	-	-	-	-	-	-
10	HL	PRGA	-	-	-	-	-	-	-
11	HL	THEB	-	-	-	-	-	-	-
12	HL	VERA	-	-	-	-	-	-	-
13	HI	AIA1	-	-	-	-	-	-	Reference station
14	HI	FLO2	-	-	-	-	-	-	no (amp 2 Hz)
15	HI	GRE3	-	-	-	-	-	-	Reference station
16	HI	IGM2	-	-	-	-	-	-	no (amp 1.5 Hz)

17	HI	ITS1	-	-	-	-	-	-	no (small bb amp)
18	HI	JAN2	-	-	-	-	-	-	no (amp 3 Hz)
19	HI	JAN3	-	-	-	-	-	-	Reference station
20	HI	KAS2	-	-	-	-	-	-	Reference station
21	HI	KLR1	-	-	-	-	-	-	Reference station
22	HI	KNS1	-	-	-	-	-	-	Reference station
23	HI	KOZ2	-	-	-	-	-	-	Reference station
24	HI	KRK1	-	-	-	-	-	-	no (small bb amp)
25	HI	LMS2	-	-	-	-	-	-	no (amp 6 Hz)
26	HI	PLA1	-	-	-	-	-	-	Reference station
27	HI	PTO1	-	-	-	-	-	-	no (small bb amp)
28	HI	SEIS	-	-	-	-	-	-	Reference station
29	HI	SIA1	-	-	-	-	-	-	Reference station
30	HI	STL1	-	-	-	-	-	-	no (amp 2.5 Hz)

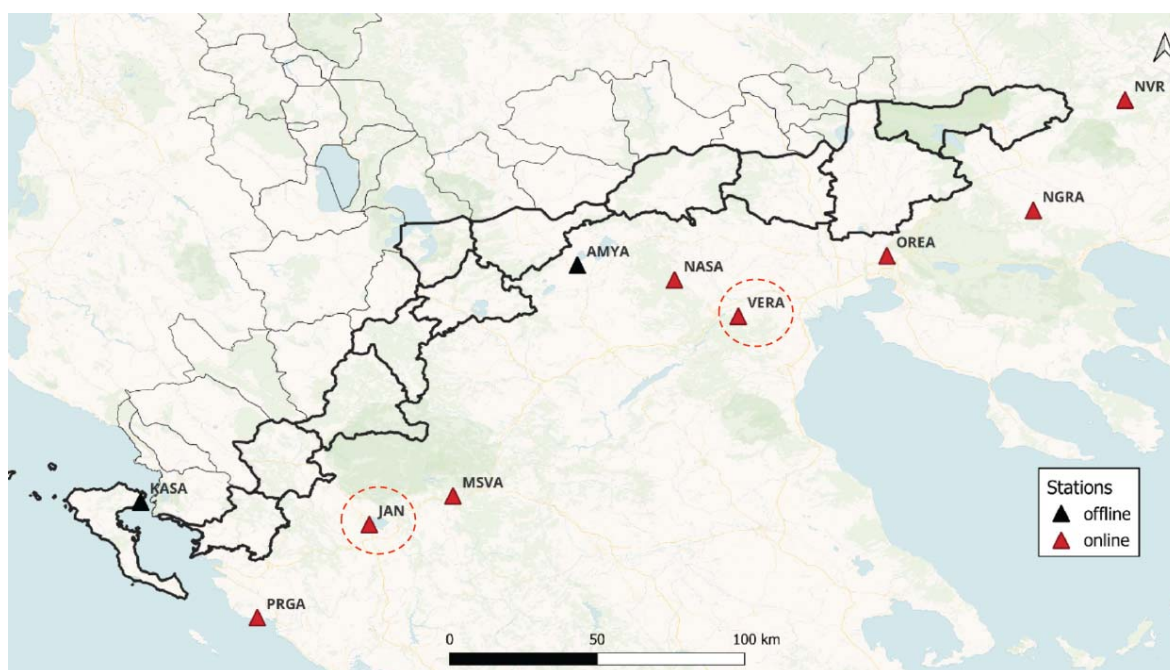
**Table 6** and **7** show all the information retrieved and the sources from which it was harvested. In more detail:

- Operator webpages include <https://accelnet.gein.noa.gr> which gives some assessment of local geology for HL stations, while [https://www.itsak.gr/en/page/infrastructures/networks/acc\\_network](https://www.itsak.gr/en/page/infrastructures/networks/acc_network) does not yield further station information for HI stations due to broken links.
- Margaris et al. (2021) provide information for some HL and HI stations on geological age and unit, topographic slope, and estimate of Vs30 based on proxies and/or boreholes at some distance.
- Ktenidou et al. (2024) give information on some HL stations on geological age and unit, topographic slope, installation conditions and site amplification from HVSR analysis based on the recorded data. Information sources come from the operator as well as external sources. Based on these parameters, assessments are made as to whether each station can be considered a reference station.
- Grendas et al. (2018) give information on HI stations on site amplification from HVSR analysis based on the recorded data. Based on their HVSR curves the interpretation has been made ad hoc at this time to reach an assessment as to reference station potential.

### 3.1.3. Selection of stations to share and station health monitoring

In January 2026, NOA (HL network) signed a Memorandum of Understanding (MoU) with UKIM-IZIIS (MA network) and within that framework it shared certain accelerometric stations (HN channels) in the vicinity of the CBR in real time. In the context of this selection, 8 candidate stations were selected, with the aim of narrowing down to 6 that would be relatively equispaced along the border. Currently offline stations were not considered (KASA, AMYA).

The candidates are shown in Figure 8 and their basic parameters in **Error! Reference source not found.** below. A selection was to be made between NASA and VERA, and between JAN and MSVA. The criteria considered were amplification and noise level.

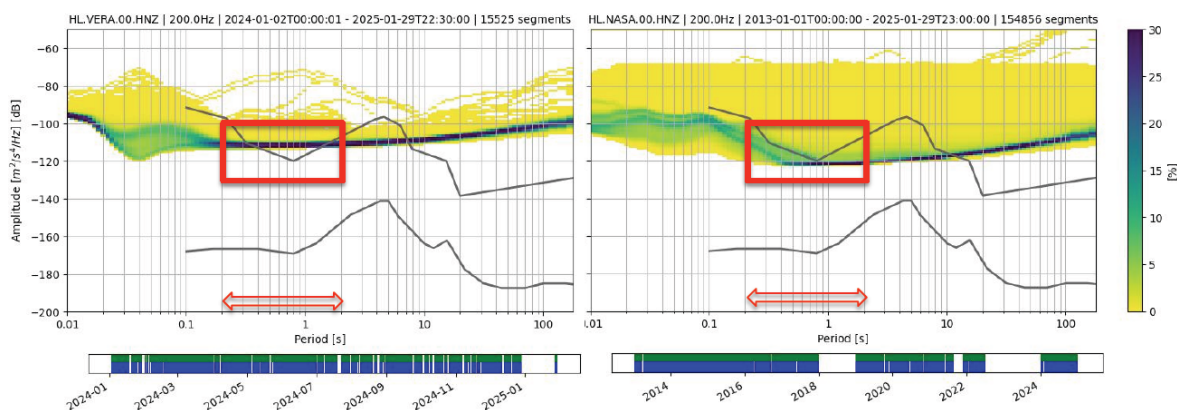


**Figure 8.** Candidate NOA stations in the vicinity of the CBR for sharing in real time with UKIM-IZIIS. Red circles indicate the ones not selected and black markers the offline ones

Number	Station code	Location	Latitude	Longitude	Elevation [m]	Site	Building	Sensor Description	Sampling rate [Hz]
1	JAN	IOANNINA	39.65616	20.84874	526	Seismic Station	1-storey RC	CMG-5TDE	200
2	MSVA	METSOVO	39.7704	21.1828	1157	Town Hall	3-storey masonry	CMG-5TDE	200
3	NASA	NAOUSSA	40.63111	22.06706	350	Town Hall	3-storey RC	CMG-5TDE	200
4	NGRA	NIGRITA	40.90747	23.49933	68	Town Hall	3-storey RC	CMG-5TDE	200
5	NVR	KATO NEVROKOPI	41.34846	23.86517	627	Seismic Station	1-storey RC	CMG-5TDE	200
6	OREA	ORAIOKASTRO	40.72705	22.91452	257	Town Hall	2-storey RC	CMG-5TDE	200

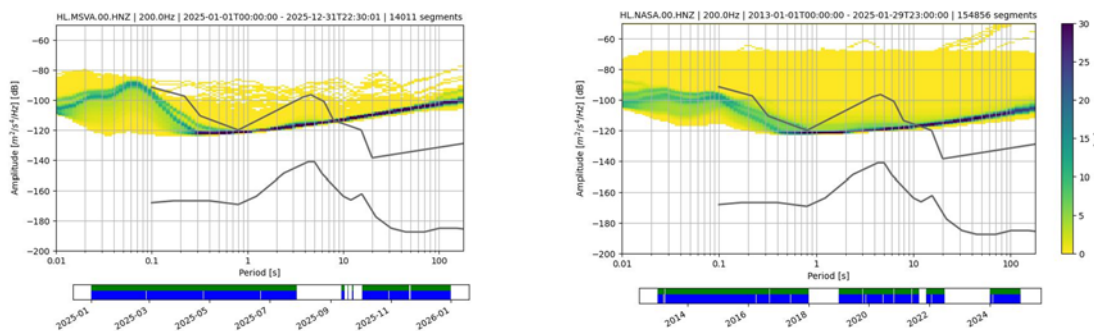
7	PRGA	PARGA	39.28557	20.40157	15	Town Hall	2-storey RC	CMG-5TDE	200
8	VERA	VERGINA	40.48601	22.32151	117	Town Hall	2-storey RC	CMG-5TDE	200

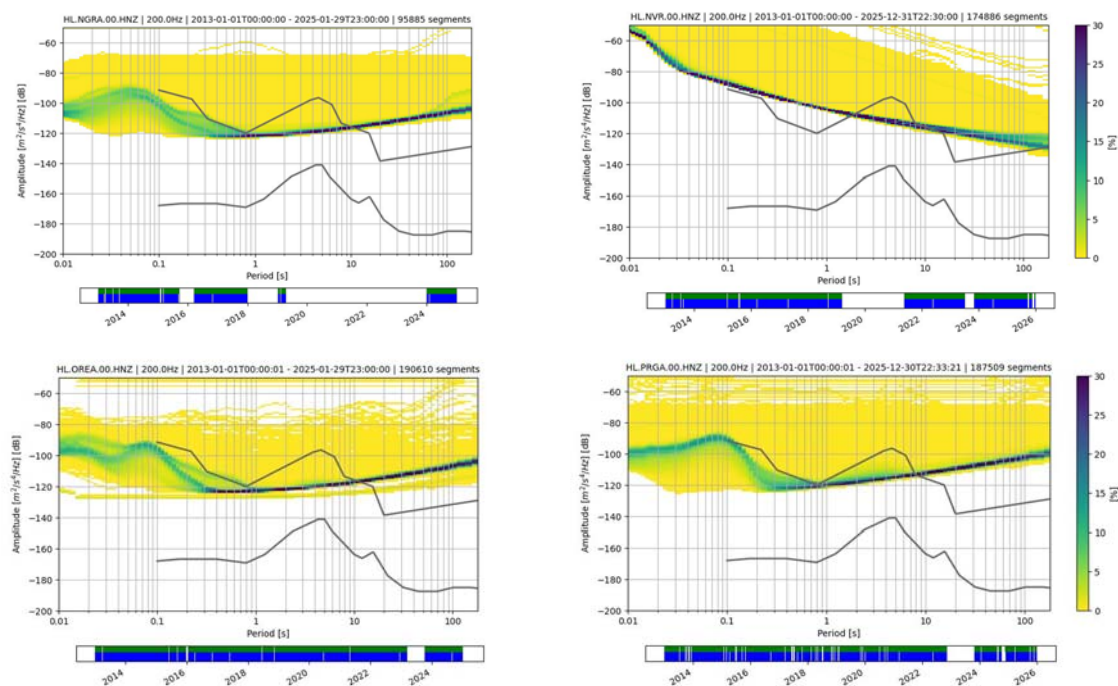
In **Table 6** and **7** above, it is seen that none of these is considered to lie on hard rock, so some amplification may be expected at all of them. JAN was analysed in Ktenidou et al. (2014) and indeed exhibited some broadband amplification. None of them exhibits strong topographic slope. A study was made of the noise level at the candidate stations, and out of each pair, the one with the lowest noise level during its period of operation was chosen. **Figure 9** shows the comparison between NASA and VERA. It depicts the power spectral densities of noise spectra during the operation of each sensor, for the vertical component (HNZ channel). Colored lines depict recorded noise while black lines show upper and lower bounds from Peterson’s (1993) global noise model. In the range between 0.2-2.0 s (0.5-5.0 Hz), shown in red, which would include the eigenperiods of most structures of interest (2 stories and above), NASA has a lower noise level.



**Figure 9.** Noise level comparison at nearby HL stations NASA (right) and VERA (left) to select the optimum one (NASA)

Hence, NASA was chosen over VERA and similarly, MSVA was chosen over JAN. Hence JAN and VERA are indicated with dashed lines in Figure 9. **Figure 10** shows the noise level for the 6 stations finally selected for real-time data sharing within this WP.





**Figure 10.** Noise level at the NOA stations in the vicinity of the CBR selected for sharing in real time with UKIM-IZIIS

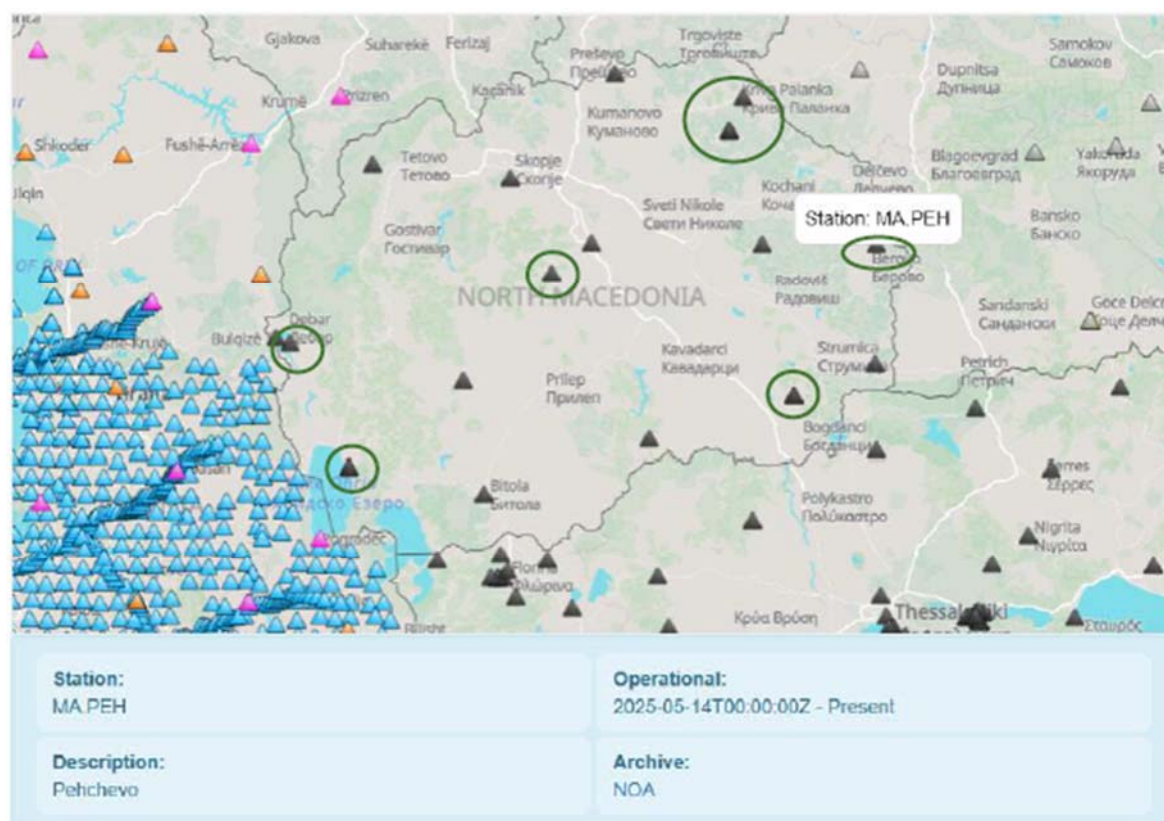
### 3.2. North Macedonia

The North Macedonian Strong Motion Network started the initiation of ORFEUS-EIDA integration in 2023. The main purposes were to make UKIM-IZIIS strong motion data interoperable with European repositories and to align with FAIR principles (Findable, Accessible, Interoperable, Reusable) for open data sharing.

Following the current situation the main activities for data integration were completed:

- Memorandum of cooperation was initiated and signed between the institutions – UKIM-IZIIS and NOA (Annex 1);
- Established connection with the EIDA-NOA node for data sharing, DOI number for the network was provided [DOI: 10.7914/g4hj-4553](https://doi.org/10.7914/g4hj-4553), Network Code MA;
- SeisComP software was installed and configured for station visibility;
- Different types of instruments, Güralp CMG-5TD and ETNA-2 were incorporated into the network, and the stations are visible on the platform;
- Data streaming check for the connected stations.

Figure 11 presents the UKIM-IZIIS strong motion stations integrated into the EIDA network (green circles, the other stations are from the Network Code MK operated by the Seismological Observatory in Skopje).



**Figure 11.** Integrated UKIM-IZIIS strong motion monitoring capacities into the ORFEUS-EIDA

### 3.3. Albania

The Albanian Seismological Network (ASN) (Institute of GeoSciences, Polytechnic University of Tirana (2002). Albanian Seismological Network [Data set]. International Federation of Digital Seismograph Networks. <https://doi.org/10.7914/SN/AC>) is managed by the Department of Seismology of the Institute of Geosciences (DS-IGEO). The AC network's current configuration includes 28 stations, of which 27 are accelerometric. The backbone of the ASN is formed by 13 broadband stations, recently expanded and densified by 9 new stations equipped with short-period sensors. Most of the seismic stations are collocated with accelerometric sensors.

Data sharing to EIDA is performed through the INGV node. Currently, 12 of the seismic stations are already being shared, namely B. Curri (BCI), Berati (BERA), Korça (KBN), Leskoviku (LSK), Laçi (LACI), Peshkopia (PHP), Puka (PUK), Shkodra (SDA), Saranda (SRN), Tepelena (TPE), Vlora (VLO), and Tirana (TIR), which is also a MedNet (MN) station, and can be accessed using either the EIDA or INGV FDSN web services to retrieve metadata and seismic data.

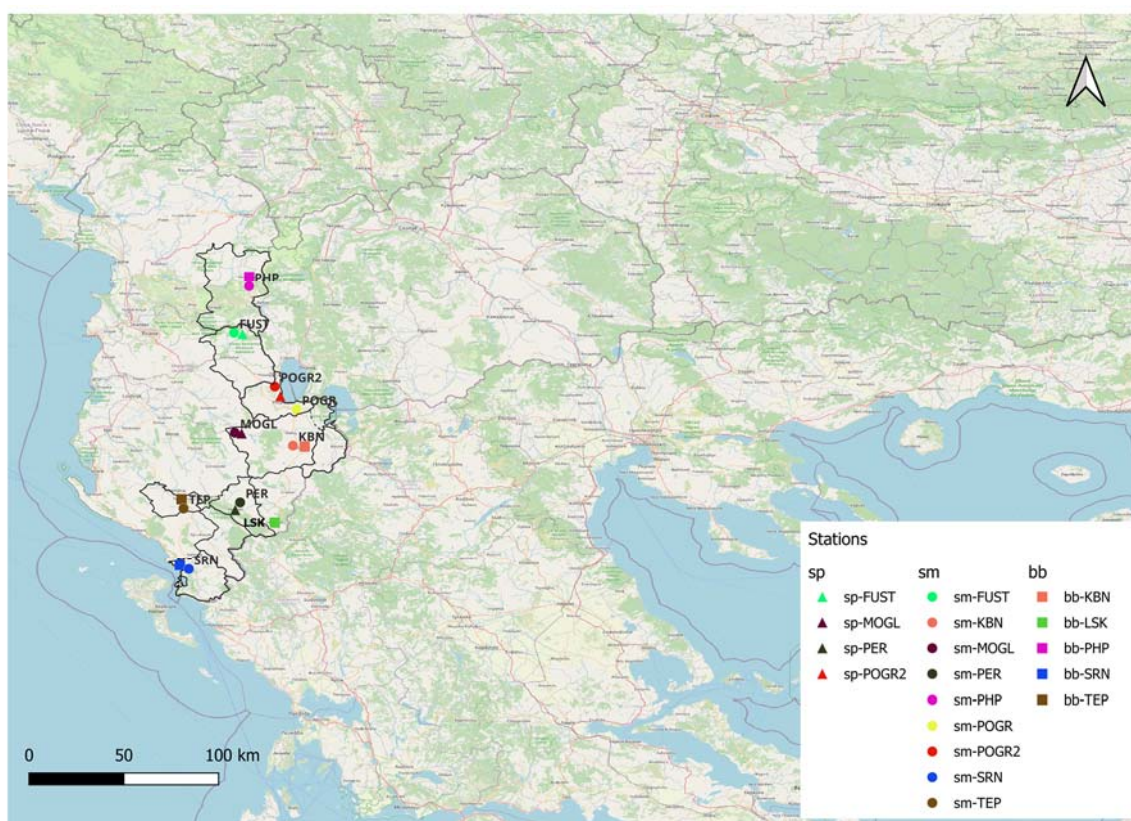
Even though most of the stations have collocated accelerometric sensors, data sharing of the strong-motion data has not been concluded yet, as this part of the network has

undergone infrastructure development and the sharing protocols were not defined between IGEO and INGV for these data.

Since the addition of the last 10 new stations (9 short-period and 1 broadband collocated with accelerometric sensors), metadata sharing has been initiated for these stations and all the accelerometric sensors. We have shared the full metadata history and have decided on the protocols to be used to share accelerometric data as well.

The procedure has been completed on our side, and we are currently awaiting implementation by INGV, which will initiate data storage and distribution to all EIDA partners.

As part of the CBR, anticipating the EIDA actions as explained above, DS-IGEO has started exchanging data with UKIM-IZIIS by establishing the corresponding MoC and selecting the relevant stations: Moglica (MOGL), Fushë Stude (FUST), Pogradeci (POGR2/POGR), and Peshkopia (PHP). These stations could also be increased as proposed by the stations distributed on the map (**Figure 12**).



**Figure 12.** Candidate IGEO stations in the vicinity of the CBR for sharing in real time with UKIM-IZIIS

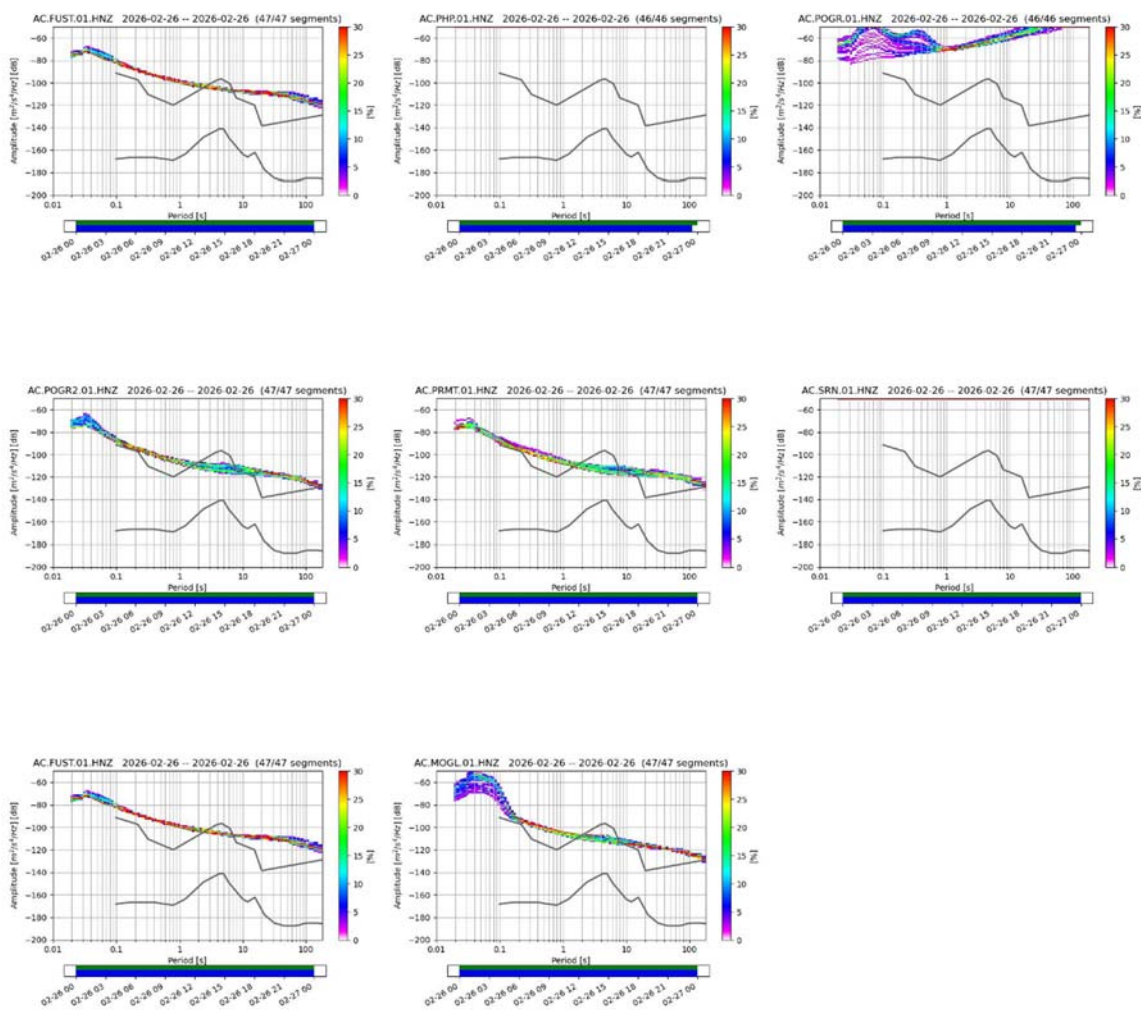
### 3.3.1 Selection of stations to share and station health monitoring

This section presents the metadata of the Albanian Strong-Motion Network (ASMN), including station identification, installation characteristics, site conditions, geographical coordinates, and elevation. The metadata table below summarizes the technical and site-specific parameters of the accelerometric stations currently in operation.

**Table 8.** Metadata of the Albanian Strong-Motion Network (ASMN)

Number	Network code	Station code	Lithology (accelnet.gein.noa.gr)	Geologic Age	Geologic description	Slope (degrees)	Preferred VS30 for analysis (m/s)	Eurocode Soil Class
1	AL	DURR	-	Quaternary	Quaternary sed. (Sand+Clay)	-	202	C
2	AL	TIR	-	Quaternary	Quaternary sed. (Clay)	-	312	C
3	AL	POGR	-	Quaternary	Quaternary sed. (Clay)	-	352	C
4	AL	VLO	-	Quaternary	Sandstones + Quaternary cover	-	365	C
5	AL	FIER	-	Quaternary	Quaternary sed. (Clay)	-	375	C
6	AL	ELBA	-	Quaternary	Quaternary sed. (Gravel+Clay)	-	405	B
7	AL	TIR1	-	-	Sandstones	-	543	B
8	AL	BCI	-	-	Limestones	-	630	B
9	AL	TPE	-	-	Limestones	-	688	B
10	AL	KBN	-	-	Sandstones	-	743	B
11	AL	KKS	-	-	Magmatic	-	748	B
12	AL	BERA	-	-	Limestones	-	1010	A
13	AL	PHP	-	-	Evaporite sedim.	-	1057	A
14	AL	SDA	-	-	Limestones	-	1113	A
15	AL	LACI	-	-	Limestones	-	1493	A
16	AL	SRN	-	-	Limestones	-	1515	A
17	AL	BELS	-	-	-	-	-	-
18	AL	BURR	-	-	-	-	-	-
19	AL	DRSH	-	-	-	-	-	-
20	AL	FUST	-	-	-	-	-	-
21	AL	HIMA	-	-	-	-	-	-
22	AL	MOGL	-	-	-	-	-	-
23	AL	PLSA	-	-	-	-	-	-
24	AL	POGR2	-	-	-	-	-	-
25	AL	PRMT	-	-	-	-	-	-
26	AL	RZM	-	-	-	-	-	-
27	AL	VLO2	-	-	-	-	-	-

In addition to the metadata description, Probabilistic Power Spectral Density (PPSD) analyses were performed for the strong-motion stations in order to evaluate the ambient noise levels and frequency-dependent performance of the installed sensors. The PPSD plots provide insight into background seismic noise conditions and station quality (**Figure 13**).



**Figure 13.** Probabilistic Power Spectral Density (PPSD) plots for the Albanian Strong-Motion Network stations

## 4. Concluding remarks

The results of Tasks T4.1 (CBR Strong Motion Capacities) and T4.2 (Integration of CBR Strong Motion Monitoring Capacities) are presented in this report. Initially, comprehensive documentation and evaluation of the existing strong-motion network capacities of CBR was conducted. Subsequently, the strong-motion network of North Macedonia was successfully integrated into the ORFEUS-EIDA platform through NOA's regional node. In parallel, a criteria-based selection of Greek accelerometric stations, including a detailed assessment of their noise levels, was carried out to determine their suitability for real-time data sharing within the CBR framework. Furthermore, a systematic effort was undertaken to develop a guideline procedure for the complete compilation of site and station metadata, using the selected Greek stations as a testbed for implementation and validation. Table 10 presents the key information on the stations that have been integrated and shared within the CBR framework, while Figure 14 provides a visualization of these stations by contributing partner.

**Table 9.** Integrated stations in the CBR – main information

Label	Station code	Location	Latitude	Longitude	Elevation [m]
<b>Greece</b>					
G-1	MSVA	METSOVO	39.7704	21.1828	1157
G-2	NASA	NAOUSSA	40.63111	22.06706	350
G-3	NGRA	NIGRITA	40.90747	23.49933	68
G-4	NVR	KATO NEVROKOPI	41.34846	23.86517	627
G-5	OREA	ORAIOKASTRO	40.72705	22.91452	257
G-6	PRGA	PARGA	39.28557	20.40157	15
<b>North Macedonia</b>					
M-1	DBR	DEBAR	41.49469	20.49863	520
M-2	SKI	SKOPJE	41.98017	21.42538	350
M-3	PES	SKOPJE	41.99712	21.42105	127
M-4	GLO	GLOBOCICA	41.33776	20.63599	692
M-5	KPAL	KRIVA PALANKA	42.2091	22.36306	849
M-6	LIS	LISICE	41.6875	21.59786	429
M-7	OHR	OHRID	41.11149	20.7899	744
M-8	PEH	PEHCHEVO	41.77628	22.89772	1114
M-9	VAL	VALANDOVO	41.32151	22.5645	179
M-10	ZLT	ZLETOVICA	42.10928	22.30667	1020
<b>Albania</b>					
A-2	PHP	PESHKOPIA	41.6847	20.4408	670
A-3	POGR	POGRADEC	40.89961	20.67903	739.4
A-4	POGR2	POGRADEC	40.93762	20.63401	746.7
A-5	TIR	TIRANA	41.3472	19.8631	247
A-6	FUST	FUSHE STUDEN	41.32515	20.39696	1161

A-7	MOGL	MOGLICA	40.70541	20.39158	496.7
A-8	KBN	KORÇA	40.62307	20.78591	892.4
A-9	PRMT	PËRMETI	40.22869	20.3515	294
A-10	SRN	SARANDA	39.88	20.005	20
A-11	TPE	TEPELENA	40.29481	20.01558	253.9

Finally, in line with international best practices, particular emphasis is placed on the proper citation of seismic data. This includes correct network attribution using FDSN codes (International Federation of Digital Seismograph Networks), the use of DOIs (Digital Object Identifiers), and full bibliographic referencing (Pedersen et al., 2025). These practices are fully aligned with Europe’s objectives for FAIR data (Findable, Accessible, Interoperable, and Reusable), and every effort has been made throughout this deliverable to ensure compliance with these principles.

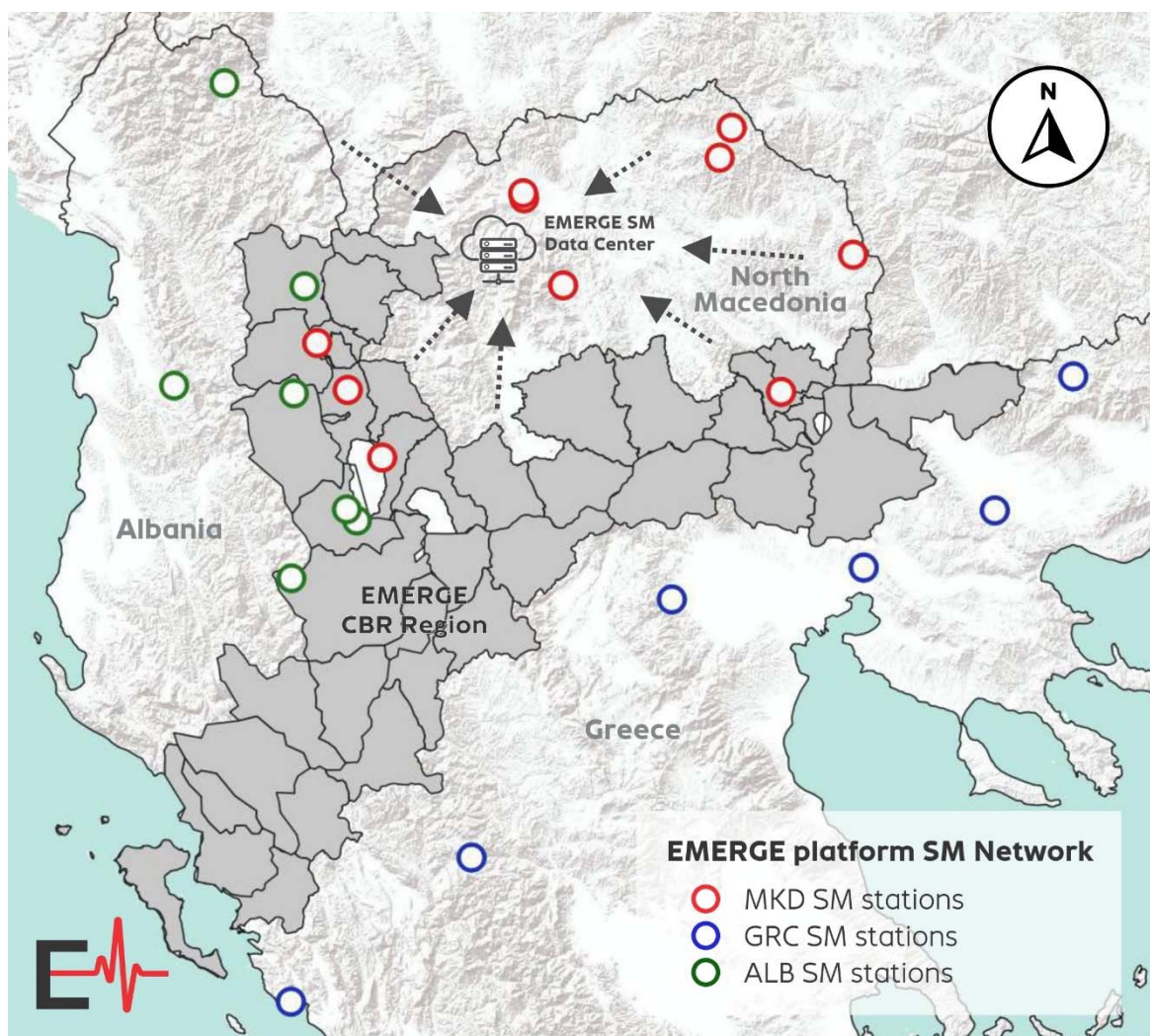


Figure 14. Integrated CBR strong motion network

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## Annex 1 – MoU between NOA and IZIIS

ΡΕΠΥΒΑΝΚΑ ΣΕΙΣΜΩΝ ΒΑΛΚΑΝΩΝ  
 ΙΝΣΤΙΤΟΥΤΟΤΗΤ "ΟΙ. ΚΑΡΠΗΣ Η ΒΕΤΟΥΛΗ" – ΣΕΙΣΜΟΛ  
 Πρωτόκολλο συνεργασίας και αμοιβαία ανταλλαγής δεδομένων

Επ. 03-176/1  
 04.02 2026 ραδ.  
 Γ Κ Ο Π Δ

**MEMORANDUM OF UNDERSTANDING**

between

The National Observatory of Athens, Institute of Geodynamics (NOA)

and

Institute of Earthquake Engineering and Engineering Seismology (IZIIS)

The representatives of them affirm their common interest for cooperation and research in Seismology, Geology and Geodynamics in the extended area of the Balkans, wishing to improve already existing cooperative mutual professional and scientific relationships, especially to enhanced realtime seismic data exchange.

**AREAS OF COOPERATION**

1. Initiate and pursue cooperative projects to monitor and study earthquakes in the Balkans region;
2. Maintain and promote channels of cooperation and communication with the aim of realizing the exchange of seismological data from strong-motion (SM) stations in real time;
3. Education of new generation of scientists;
4. Joint implementation of human capacity building activities (workshops, trainings, seminars, specialists courses) in the fields of particular interest;
5. Co-partnership in national, regional and international projects;
6. Exchange of expertise

More specifically, the cooperation will be framed by the following:

**A. Strong-Motion Networks in the Balkans:**

NOA, the operator of the HL seismic network, shall:

1. provide realtime acquisition of seismic data from HL strong-motion seismic stations through dedicated transmission lines to its main acquisition data center.
2. ensure technical control and maintenance of NOA (HL) seismic stations.
3. allow and maintain realtime exchange of seismic data from NOA data center to IZIIS data center for the following HL strong-motion stations: PRGA, MSVA, NASA, OREA, NGRA, NVR.

IZIIS, the operator of the MA seismic network, shall:

1. provide realtime acquisition of seismic data from MA strong-motion stations through dedicated transmission lines to its main acquisition data center.
2. ensure technical control and maintenance of MA stations.
3. allow and maintain realtime exchange of seismic data from IZIIS data center to NOA data center for the following MA strong motion stations: LIS, OHR, PEH, DBR, VAL, GLO

**B. Data Management**

NOA in accordance with its prevailing regulations and official agreements shall:

1. perform the tasks and provide the services required from an ORFEUS EIDA Primary Node.
2. maintain and make available SM waveform data and metadata from stations LIS, OHR, PEH, DBR, VAL, GLO through the regional NOA EIDA node to RISM and the international scientific community.
3. maintain and keep updated metadata of the HL seismic network. Notify, as soon as possible, the IZIIS data center for any updates.

IZIIS shall:

1. maintain and keep updated metadata of the MA strong motion network. Notify, as soon as possible NOA EIDA Primary node and its data center for any updates.

**PUBLICATION OF INFORMATION AND RESULTS**

Both parties agree not to disclose to a third party, nor use for commercial profit, or publish, any scientific or technical information obtained from the other party or the results advanced through the joint cooperation, unless a written consent has been provided by the other party. In later case the proper citations of networks had to be provided by official name of the network and DOI, as follows:

- National Observatory of Athens, Institute of Geodynamics, Athens. (1975). *National Observatory of Athens Seismic Network* [Data set]. International Federation of Digital Seismograph Networks. <https://doi.org/10.7914/SN/HL>.
- Institute of Earthquake Engineering and Engineering Seismology, University "Ss.Cyril and Methodius", UKIM-IZIIS Skopje, R.N.Macedonia'. (1972). IZIIS [Data set]. International Federation of Digital Seismograph Networks. <https://doi.org/10.7914/g4hj-4553>

**THE LIAISON OFFICERS IN CHARGE**

Each collaborating Institution has appointed the liaison officer who is especially in charge to regularly and timely inform other data users about any change in terms of data accuracy.

The liaison officers in charge of coordinating the activities listed in the areas of cooperation are:

1. **Dr Christos Evangelidis** from the National Observatory of Athens Seismic Network
2. **Prof. Dr. Marta Stojmanovska** from Institute of Earthquake Engineering and Engineering Seismology

**ENTRY INTO FORCE, DURATION, TERMINATION, AMENDMENT**

1. This Memorandum of Understanding shall enter into force on the date of its signature.
2. This Memorandum of Understanding shall remain valid for an initial period of five years and may be renewed by written agreement between the Parties.
3. This Memorandum of Understanding may be amended at any time, subject to the prior written agreement of both Parties.
4. This Memorandum of Understanding may be terminated by one Part upon 30 days written notice to the other Parts. If the Memorandum of Understanding is terminated by one Part, steps shall be taken to ensure that the termination does not affect any priori obligation, project or activity already in progress.
5. This Memorandum of Understanding is executed in two copies.

Athens, 29/1/2026  
For NOA

**SPYRIDON VASILAKOS**  
Digitally signed by  
SPYRIDON VASILAKOS  
Date: 2026.02.12  
12:39:12 +0200

Dr Spyridon Vasilakos  
Director and President of the NOA Board

Skopje, 29/1/2026  
For IZIIS

**Prof. Dr. Igor Georgiev**  
Digitally signed by  
Igor Georgiev  
Date: 2026.02.12  
12:39:12 +0200



Prof. Dr. Igor Georgiev  
Director of IZIIS

## Annex 2 – MoU between IGEO and IZIIS

РЕПУБЛИКА СЕВЕРНА МАКЕДОНИЈА  
УНИВЕРЗИТЕТ "СВ. КИРИЛ И МЕТОДИЈ" – СКОПЈЕ  
Институт за земјотресно инженерство и инженерска сеизмологија-Скопје

Бр. 03-2152 / 1  
29.10 20 25 год.  
С К О П Ј Е

**MEMORANDUM OF COOPERATION (MoC)  
ON BILATERAL SEISMIC DATA EXCHANGE AND SCIENTIFIC COLLABORATION**

between

The Institute of Geosciences, Rr. "Don Bosko", Nr.60, Tirana, Albania, represented by Director, Prof. Dr. Ylber Muceku

And

The Institute of Earthquake Engineering and Engineering Seismology, St. "Todor Aleksandrov", Nr. 165, Skopje, North Macedonia, represented by Director, Prof. Dr. Igor Gjorgjiev

The representatives of the above-mentioned institutions confirm their shared interest in cooperation and joint scientific research in the field of Engineering Seismology within the framework of the project "Rapid Multi-Risk Needs Evaluation and Planning Platform (EMERGE)".

This collaboration aims to strengthen cross-border multi-risk assessment capacities by enabling the rapid identification of needs for early crisis response based on near real-time evaluation of seismic and landslide risks.

In this context, the Parties express their mutual commitment to enhance existing professional and scientific relations, particularly through the exchange of real-time accelerometric data and related metadata, in order to improve interoperability, data quality, and the effectiveness of joint rapid-response systems.

The Parties have the obligation to ensure cross-border interoperability and mutual support between their respective ShakeMap systems, guaranteeing coordinated response and full coverage during strong seismic events affecting their territories.

They shall also cooperate in developing and maintaining a shared strong-motion database for the calibration of local and regional Ground Motion Prediction Equations (GMPEs), thereby improving the reliability of near real-time seismic hazard evaluation and corresponding risk assessment in cross-border areas.

**Consent and Modes of the cooperation**

Subject to technical feasibility and the approval of the Directors of the participating research institutions, the cooperation shall be implemented by the contracting parties through the following provisions:

- The above-mentioned institutions shall mutually exchange real-time strong-motion (accelerometric) data in standardized seismic data formats, together with all relevant metadata.

- The number of seismic stations for which real-time data will be exchanged shall follow a reciprocity model, to be jointly determined and periodically reviewed by both institutions.
- The institutions providing data shall be responsible for the quality, integrity, and accuracy of the data supplied, including but not limited to: seismic station metadata (geographical coordinates, sensor type, instrumental response, site characteristics, Vs30, geological description, etc.), verification of the absence of systematic errors, and the minimization of seismic noise in the transmitted signals.
- The Parties shall ensure cross-border interoperability and mutual support between their respective ShakeMap systems, enabling rapid and coordinated response to strong seismic events. They shall also cooperate in developing and maintaining a joint strong-motion database for the calibration of regional GMPEs, thereby improving the reliability of real-time seismic hazard and risk assessments.
- The Parties shall jointly ensure and guarantee mutual technical cooperation and support within the framework of the data exchange agreement. This includes assisting each other in network configuration, troubleshooting of data transmission, synchronization of metadata standards, and maintenance of real-time connectivity to secure continuous and reliable data flow between both institutions.
- Each collaborating institution shall designate, under this Protocol, a liaison officer responsible for maintaining regular and timely communication with the counterpart institution regarding any changes in data availability, accuracy, or station operational status.

#### **Publication of Information and Results**

Both Parties agree not to disclose to any third party, nor to use for commercial purposes or publish, any scientific or technical information received from the other Party or results obtained through joint cooperation, except with the prior written consent of both Parties. Publication of joint results shall be subject to mutual agreement, ensuring appropriate acknowledgment of each Party's contribution.

All activities related to data handling, storage, and dissemination shall comply with the applicable national legislation of each Party, as well as with the general principles of European legislation on data protection, intellectual property, and confidentiality, including, where relevant, the provisions of the General Data Protection Regulation (EU) 2016/679 (GDPR) and recognized standards of research ethics and integrity.

This Protocol will become effective as from the date of signing. It shall be approved by the authorities of both parties, according to their regulations and will be valid for unlimited period of time.

At any time, each of the Institution in the Protocol can cancel this agreement (partially or generally), with the obligation to inform other side about the reason for that fact

**Protocol liaison officers**

The Institute of Geosciences, Department of Seismology

Prof. Asoc. Dr. Edmond Dushi  
[e.dushi@geo.edu.al](mailto:e.dushi@geo.edu.al)

**Protocol liaison officers**

Institute of Earthquake Engineering and Engineering Seismology, Department for Natural and Technological Hazards and Ecology

Prof. Dr. Marta Stojmanovska  
[marta@iziis.ukim.edu.mk](mailto:marta@iziis.ukim.edu.mk)

Date: *23.10.2025*



The Institute of Geosciences

*[Handwritten signature]*

Prof. Dr. Ylber Muceku  
Director



Institute of Earthquake Engineering and Engineering Seismology

*[Handwritten signature]*

Prof. Dr. Igor Gjorgjiev  
Director

*481.prot dt. 05.11.2025*

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