Η Σεισμολογία στην Εκπαίδευση και στην Κοινωνία: Διεπιστημονική προσέγγιση με καινοτόμες μεθόδους θεατρικής αγωγής και ψηφιακών τεχνολογιών

Επιστημονική Ημερίδα 5 Μαΐου 2023, Αθήνα

Σεισμολογία των πολιτών

Νικόλαος Μελής

Διευθυντής Ερευνών

Εθνικό Αστεροσκοπείο Αθηνών – Γεωδυναμικό Ινστιτούτο

nmelis @ noa.gr

Το ερευνητικό έργο υποστηρίζεται από το Ελληνικό Ίδρυμα Έρευνας και Καινοτομίας (ΕΛ.ΙΔ.Ε.Κ.) στο πλαίσιο της Δράσης: «1η Προκήρυξη ερευνητικών έργων ΕΛ.ΙΔ.Ε.Κ. για την ενίσχυση των μελών ΔΕΠ και Ερευνητών/τριών και την προμήθεια ερευνητικού εξοπλισμού μεγάλης αξίας» (Αριθμός Έργου:1752)

Citizen Science

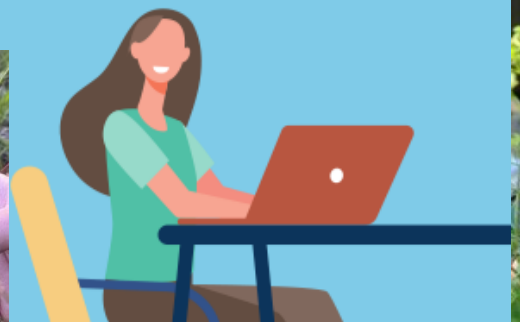
Citizen science is any activity that involves the public in scientific research and thus has the potential to bring together science, policy makers, and society as a whole in an impactful way.

eu-citizen.science Search Blog Events Moocs Forum FAQ About ECS Project

about the platform

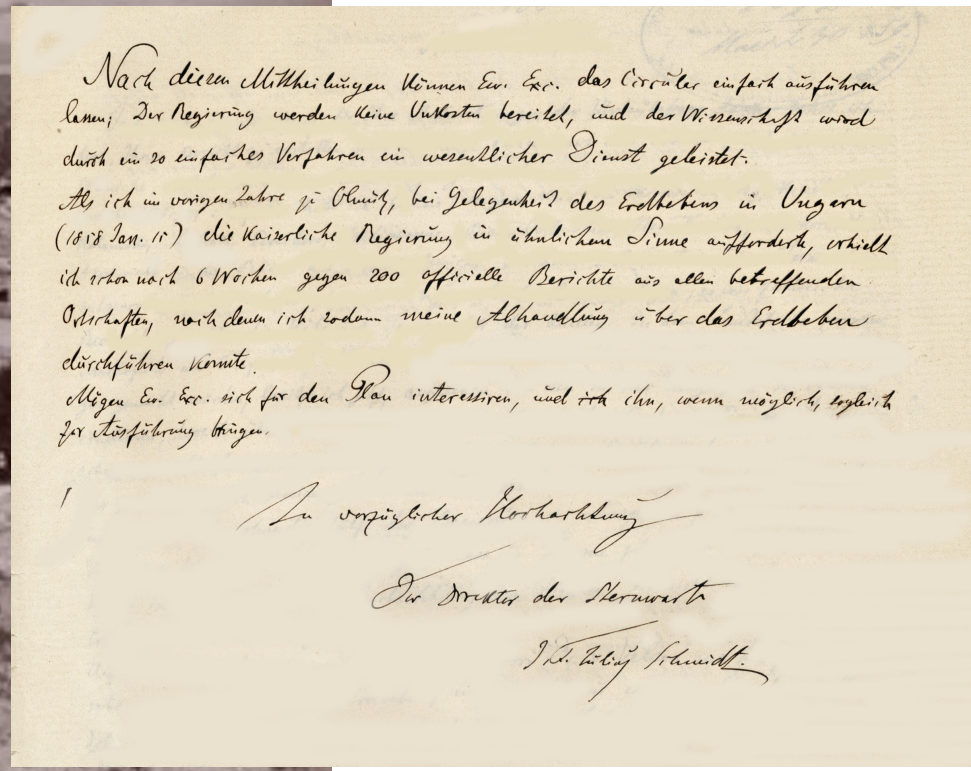
EU-Citizen.Science is an online platform for sharing knowledge, tools, training and resources for citizen science – by the community, for the community.

The vision for the platform is to serve as a Knowledge Hub and to become the European reference point for citizen science in aid of its mainstreaming.



Observatory – Παρατηρητήριο – Μετρήσεις – Βάσεις Δεδομένων

1859



Nach diesen Mittheilungen können Ew. Exc. das Circulär einfach ausführen lassen; Der Regierung werden keine Umkosten bereitet, und der Wissenschaft wird durch ein so einfaches Verfahren ein wesentlicher Dienst geleistet.
Als ich im vorigen Jahre zu Olmütz, bei Gelegenheit des Erdbebens in Ungarn (1858 Jan. 15) die Kaiserliche Regierung in ähnlichem Sinne aufforderte, erhielt ich schon nach 6 Wochen gegen 200 officielle Berichte aus allen betroffenden Ortschaften, nach denen ich sodann meine Abhandlung über das Erdbeben durchführen konnte.
Mögen Ew. Exc. sich für den Plan interessiren, und ich ihn, wenn möglich, zugleich der Ausführung übergen.

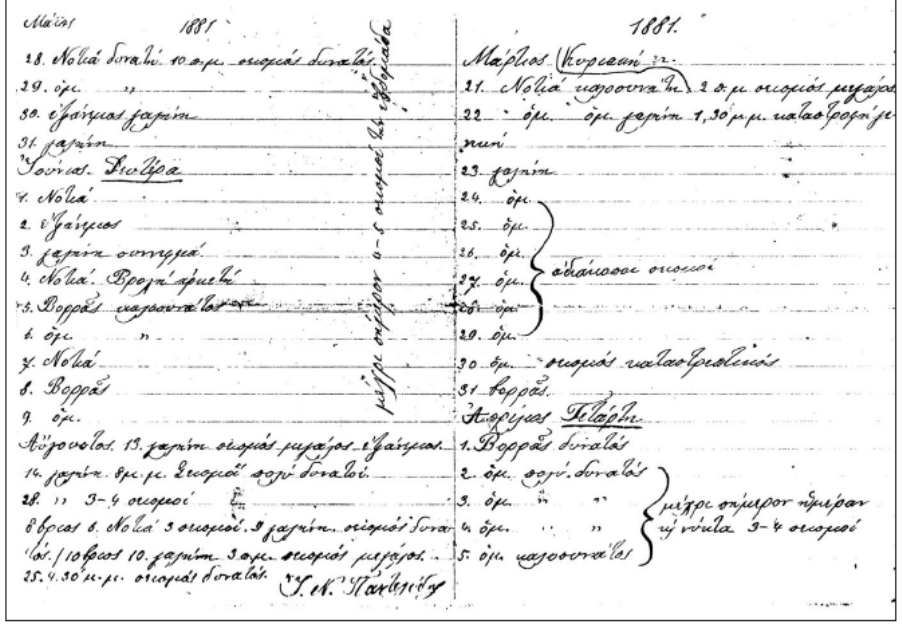
In vorzüglicher Hochachtung

Der Director der Sternwarte

J. A. Ludwig Schmidt

Kouskouna & Makropoulos 2004

Χίος 22/3_4/5 / 1881, ~M=6.5



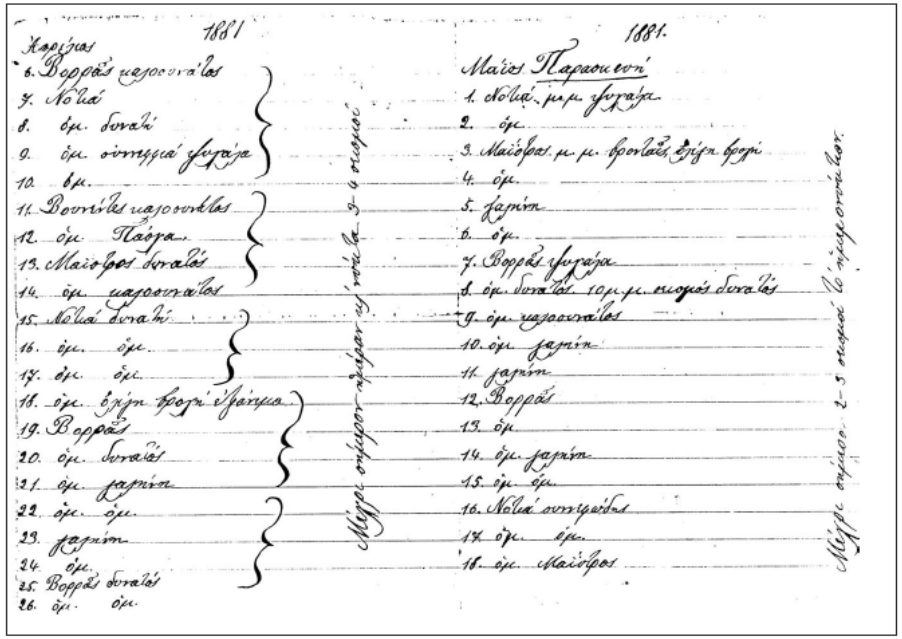


Fig. 5. Earthquake and weather report: an unpublished manuscript written by I.N. Pantelides (19th cent., further details unknown). The manuscript is kept at the Ioannis Choremis archives in Chios, Greece. It commences on Sunday, 22 March 1881 (OS-old style) and ends on 25 December 1881 (OS). The exact date and time of the mainshock of (22 March) 4 April Chios (*M* 6.5) earthquake and its aftershocks are listed.

Ένταση – Μέγεθος Σεισμού

Giuseppe Mercalli
1902

Modified Mercalli Scale		Richter Magnitude Scale
I	Only felt by sensitive instruments	1.5
II	Felt by few persons at rest, especially on upper floors, delicate suspended objects may swing	2.0
III	Felt indoors, but may not be recognized as earthquake, vibrations like large passing truck	2.5
IV	Felt indoors by many, some outdoors, may awaken some sleeping persons; dishes, windows, doors may move, cars rock.	3.0
V	Felt by most; some windows, dishes break; tall objects may fall.	3.5
VI	Felt by by all, falling plaster and chimneys, light damage but some fear.	4.0
VII	Very noticeable, damage to weaker buildings on fill; driving automobiles notice.	4.5
VIII	Walls, monuments, chimneys, bookcases fall; liquifaction; driving is difficult	5.0
IX	Buildings shifted off foundations, cracked and twisted; ground is cracked and underground pipes are broken.	5.5
X	Most structures severely damaged to destroyed; ground is cracked, rails are bent, landslides on steep slopes	6.0
XI	Few structures standing; bridges and roads severely damaged or destroyed, large fissures in ground	6.5
XII	Total damage; can see the earthquake wave move through the ground; gravity overcome and objects thrown into the air	7.0
		7.5
		8.0

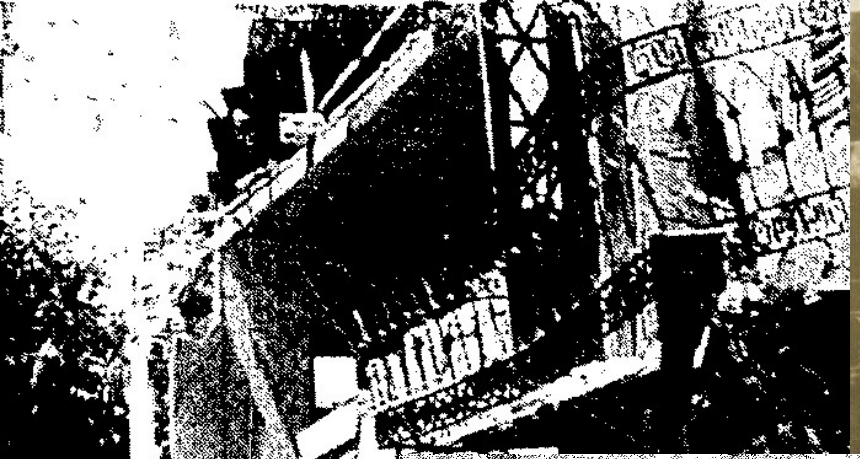
Charles Richter
1935

Επιπτώσεις

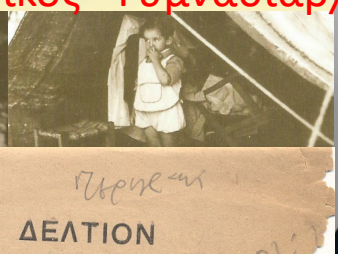
Ενέργεια

Παρατηρήσεις

Ενόργανες μετρήσεις



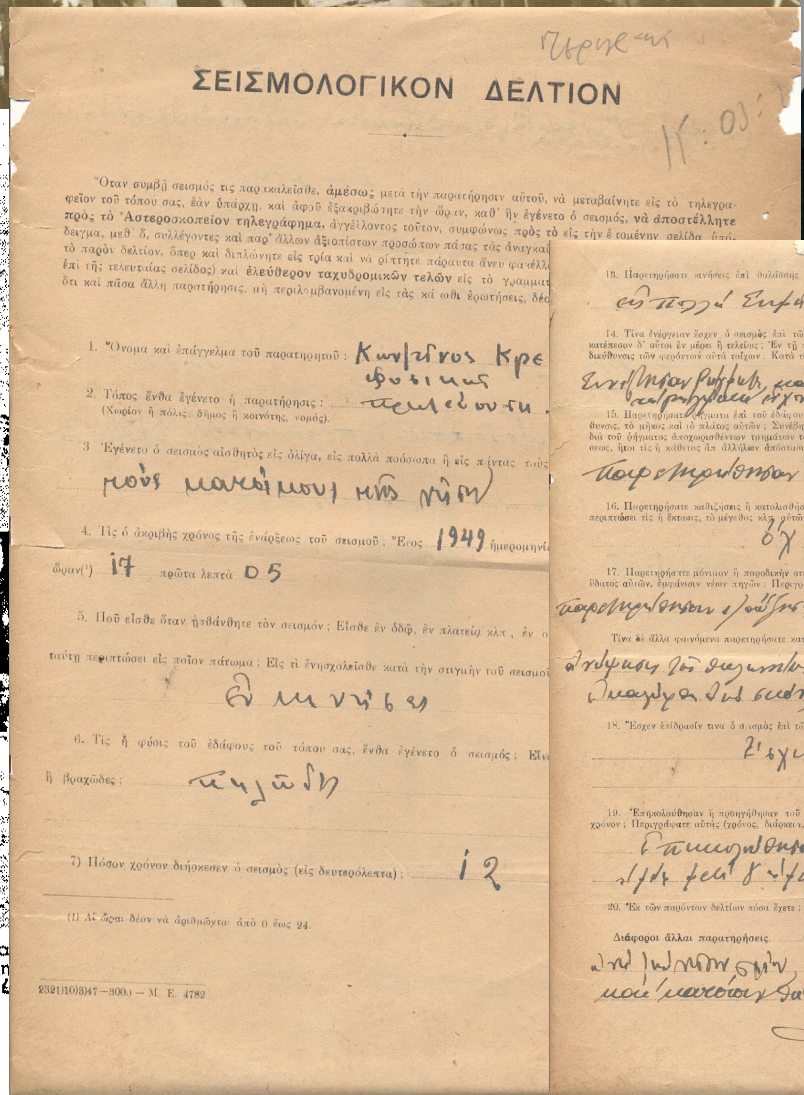
ΣΕΙΣΜΟΛΟΓΙΑ.—Οἱ σεισμοὶ τῆς Χίου τῆς 21ης Μαΐου καὶ 23 Ἰουλίου 1949, Πρόδρομος ἀνακοίνωσις, ὑπὸ *Κωνστ. Γ. Κρεατσᾶ**. Ἀνεκοινώθη ὑπὸ τοῦ κ. Ἰωάννου Τρικκαλινοῦ.



Κων/νος Κρεατσάς
Φυσικός - Γυμνασιάρχης

Τὰ Καρδάμυλα, ἡ ὡραία αὐτὴ κωμόπολις τῆς Χίου ἔχει ὑποστῆ τὰς περισσοτέρας ζημίας ἀπὸ τὸν κατα στρεπτικὸν σεισμὸν τοῦ Σαββάτου. Πολλαὶ οἰκίαι κατέρρευσαν, ἐνῷ αἱ ὑπόλοιποι ὑπέστησαν σοβαρὰς ζη μίας ὥστε νὰ καθίστανται πλέον ἀκατοίκητοι. Εἰς τὴν φωτογραφίαν κάτοικοι τῶν Καρδαμύλων πρὸ τῆς ἐ ρειπωθείσης οἰκίας των.

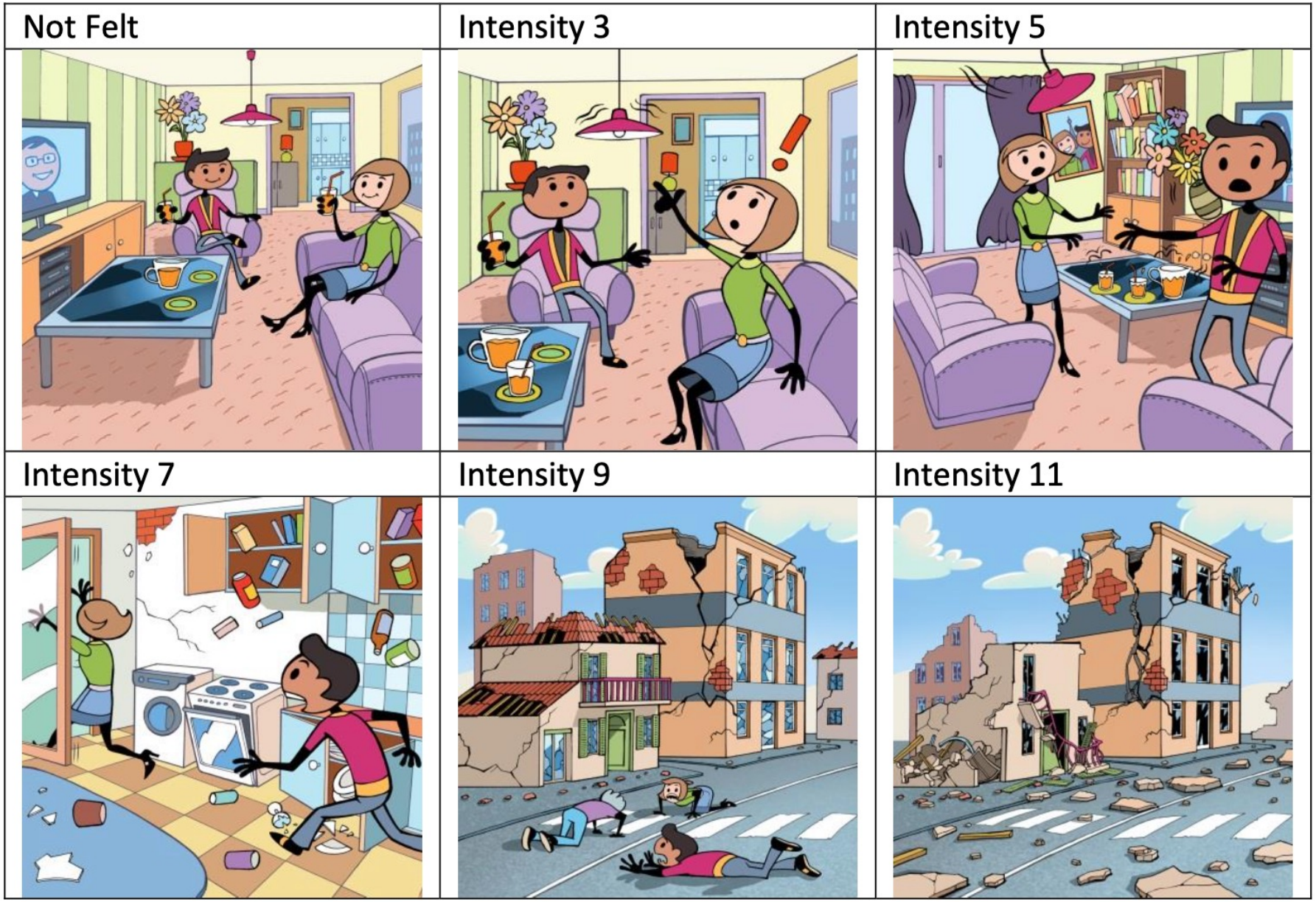
Μία ἀκόμη φωτογραφία ἀπὸ τὴν καταστραφεῖσαν Χίαν

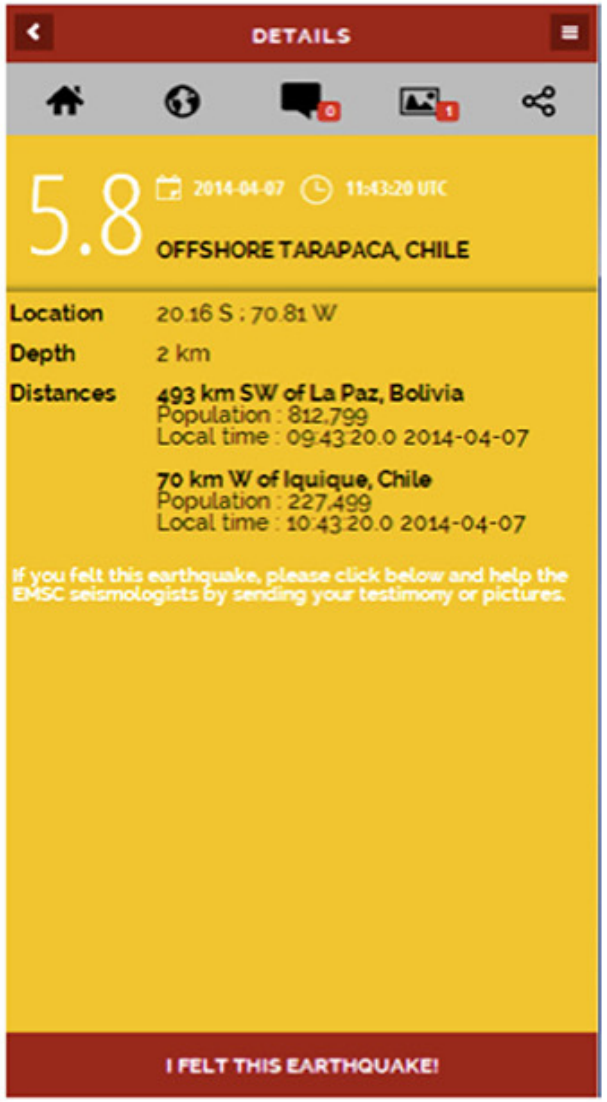


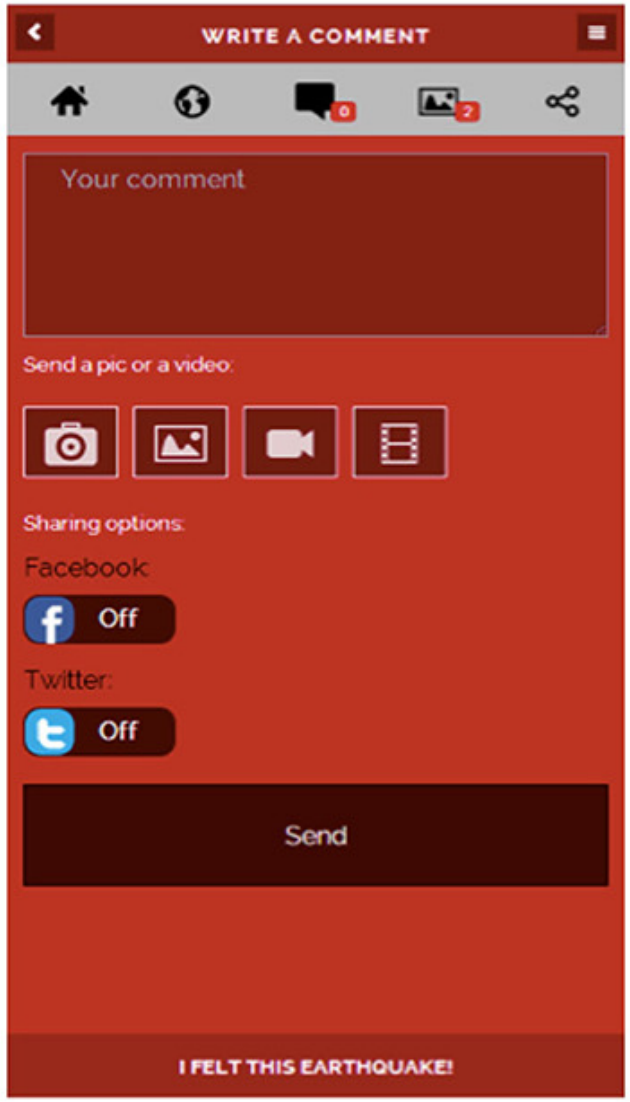
ΣΕΙΣΜΟΛΟΓΙΚΟΝ ΔΕΛΤΙΟΝ

Χίος 23/07/1949 17:04 M=6.7

Bossu, R., M. Landès, F. Roussel, and S. Hough, Thumbnail based questionnaires for the rapid and efficient collection of macroseismic data from global earthquakes, SRL, 88 (1), doi :doi:10.1785/0220160120, 2017







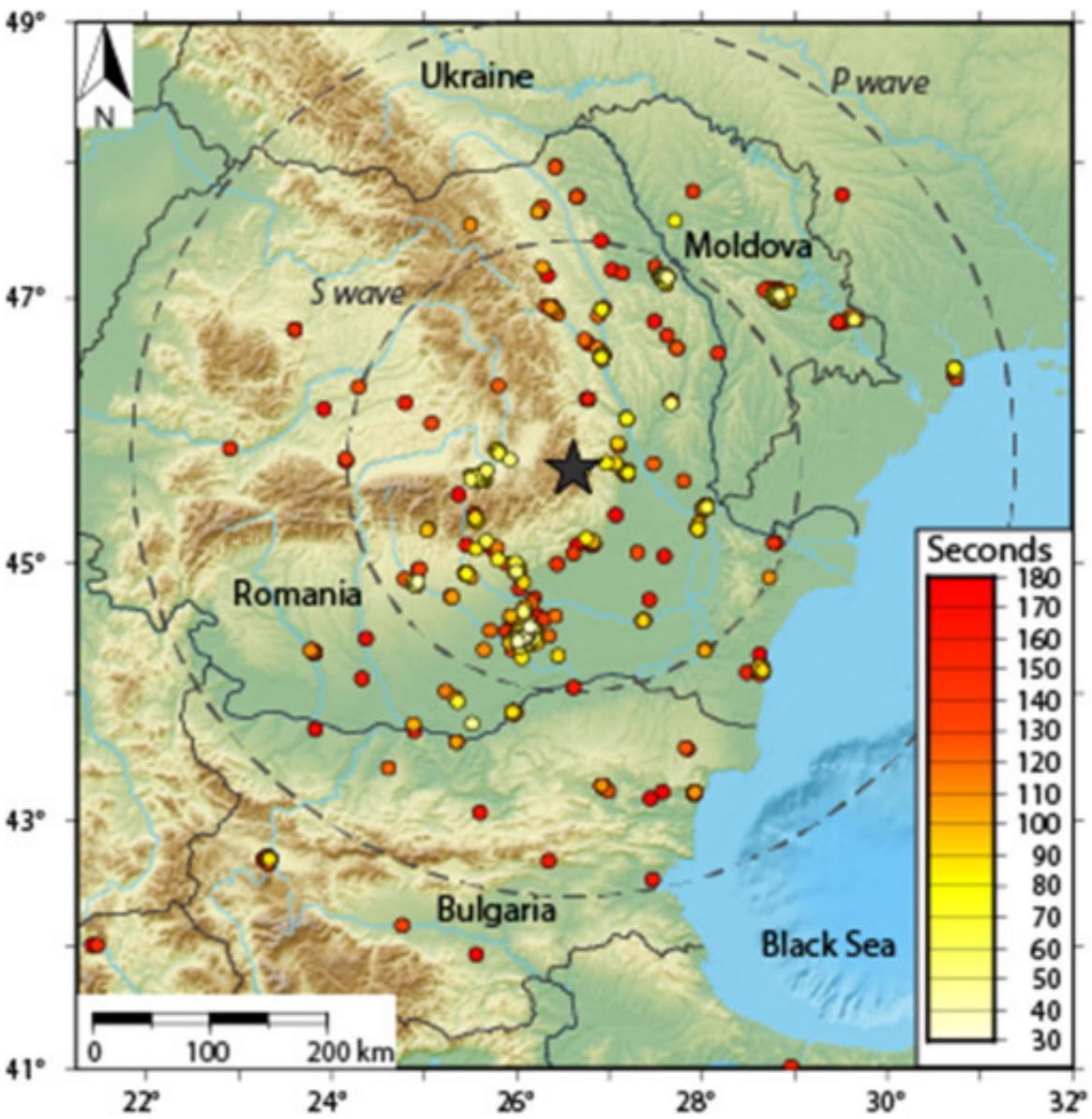
LastQuake app enables users to get information about felt earthquakes (left), leave comments and pictures about earthquakes they felt (middle) and provide information about the intensity they experienced through a set of visuals (right)

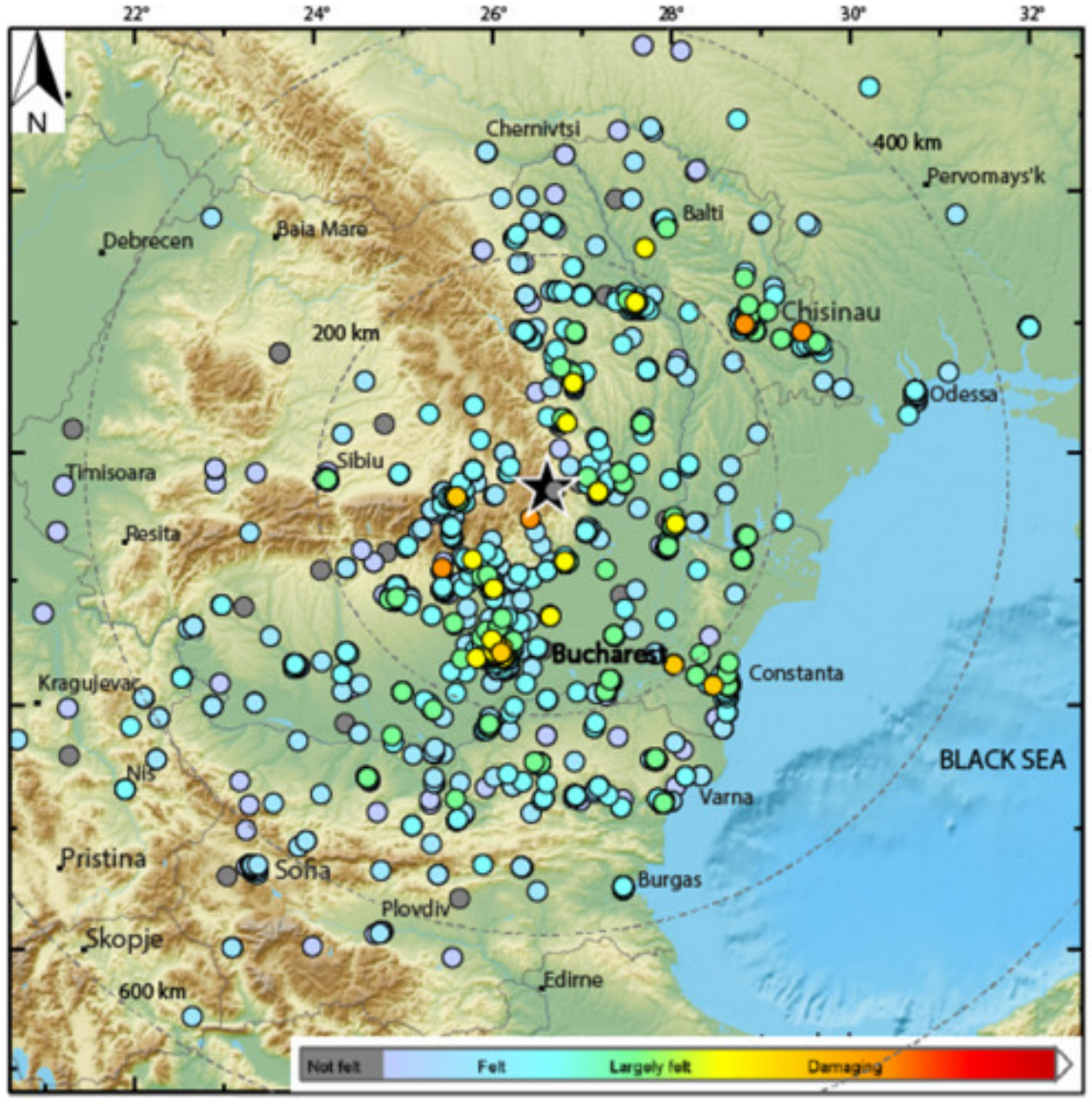
EMSC: Fallou, L., et al., 2020, Frontiers

LastQuake: From rapid information to global seismic risk reduction

EMSC: Bossu, R., et al., 2018, Int.J.Dis.R.Red.

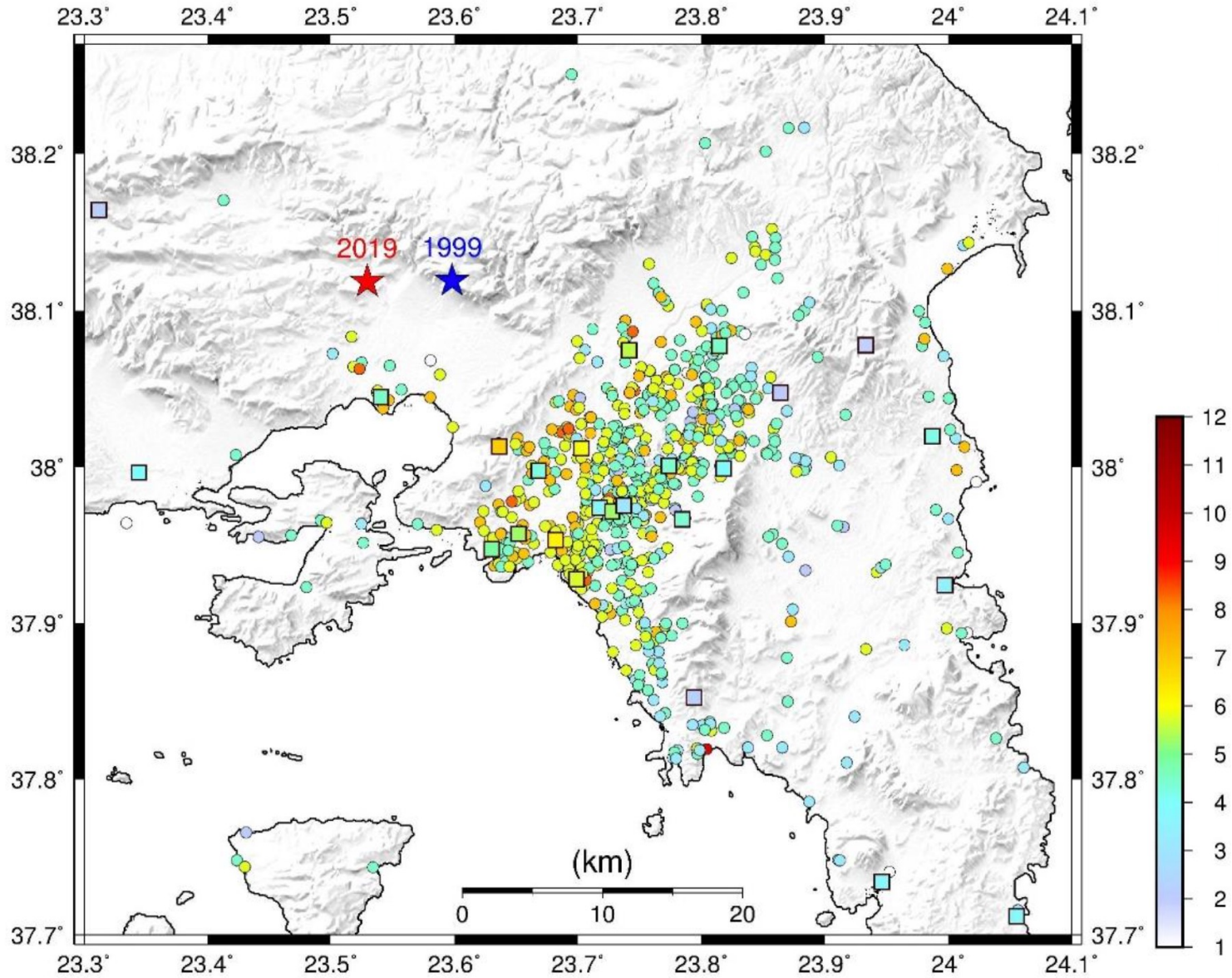
M=5.6, 91km depth, Romania, December 27, 2016
3min and 10min

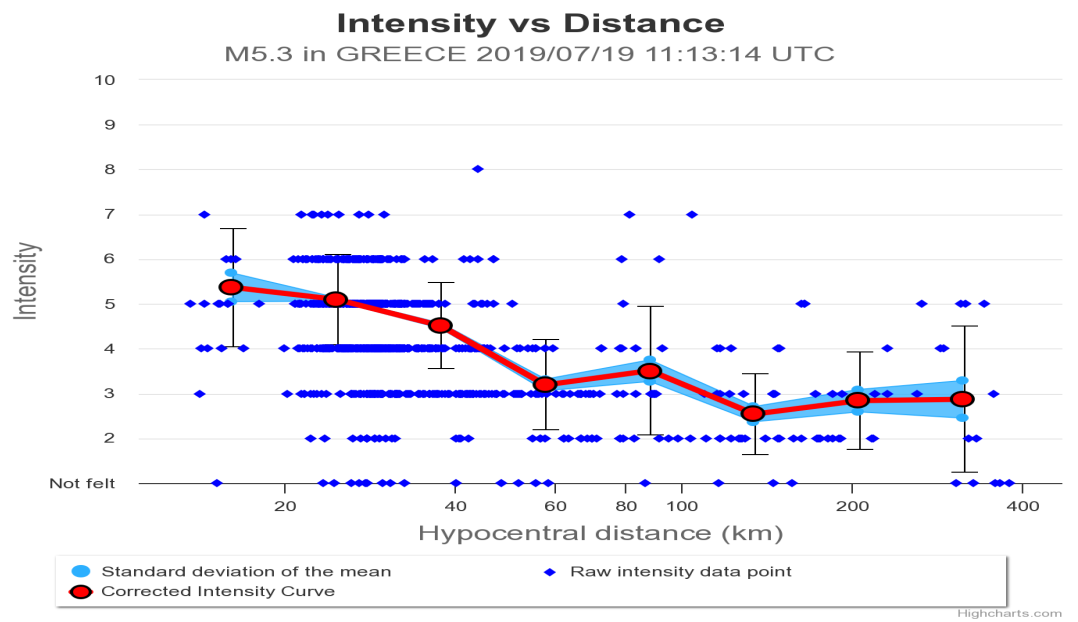


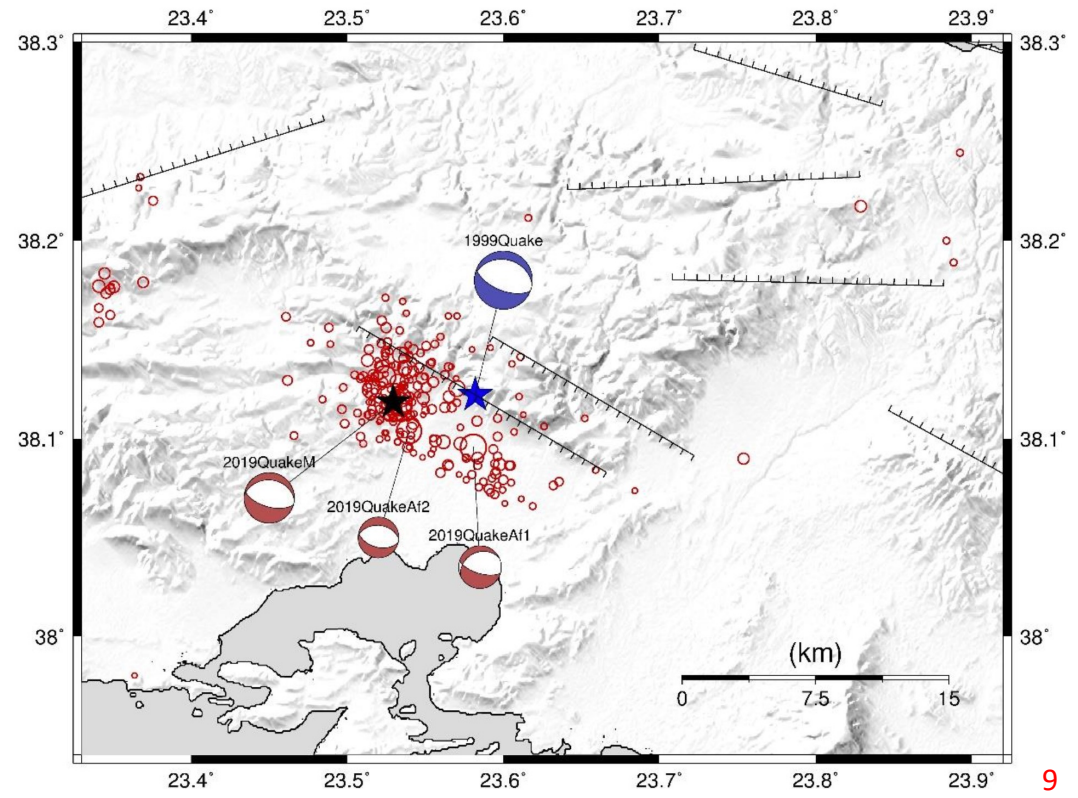


Mw=5.2 Magoula, Greece earthquake of 19 July 2019

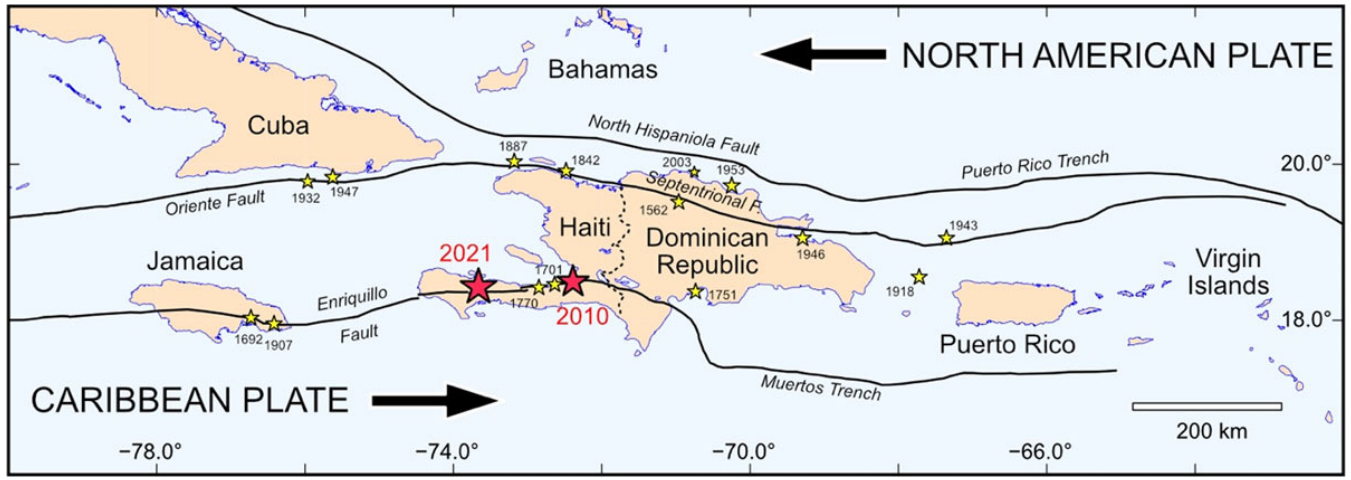
NIKOLAOS MELIS, IOANNIS KALOGERAS, NIKOS KALLIGERIS

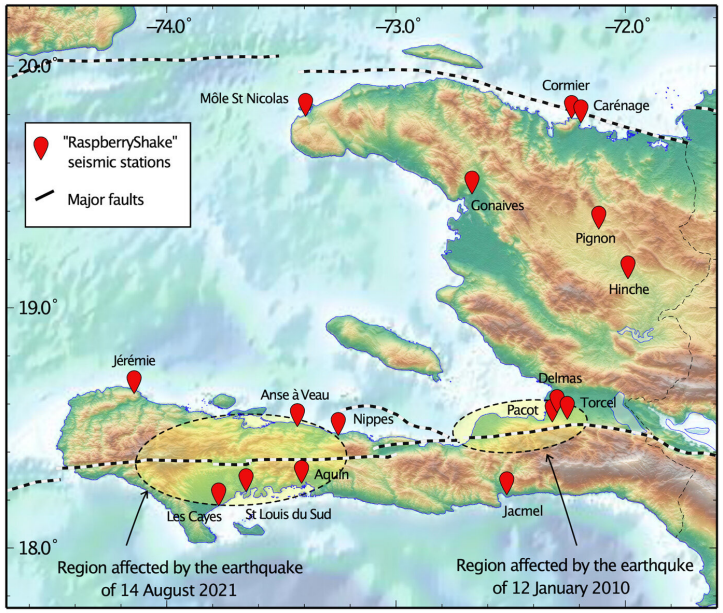






Citizen seismology helps decipher the 2021 Haiti earthquake





Calais E., et al., 2022, SCIENCE

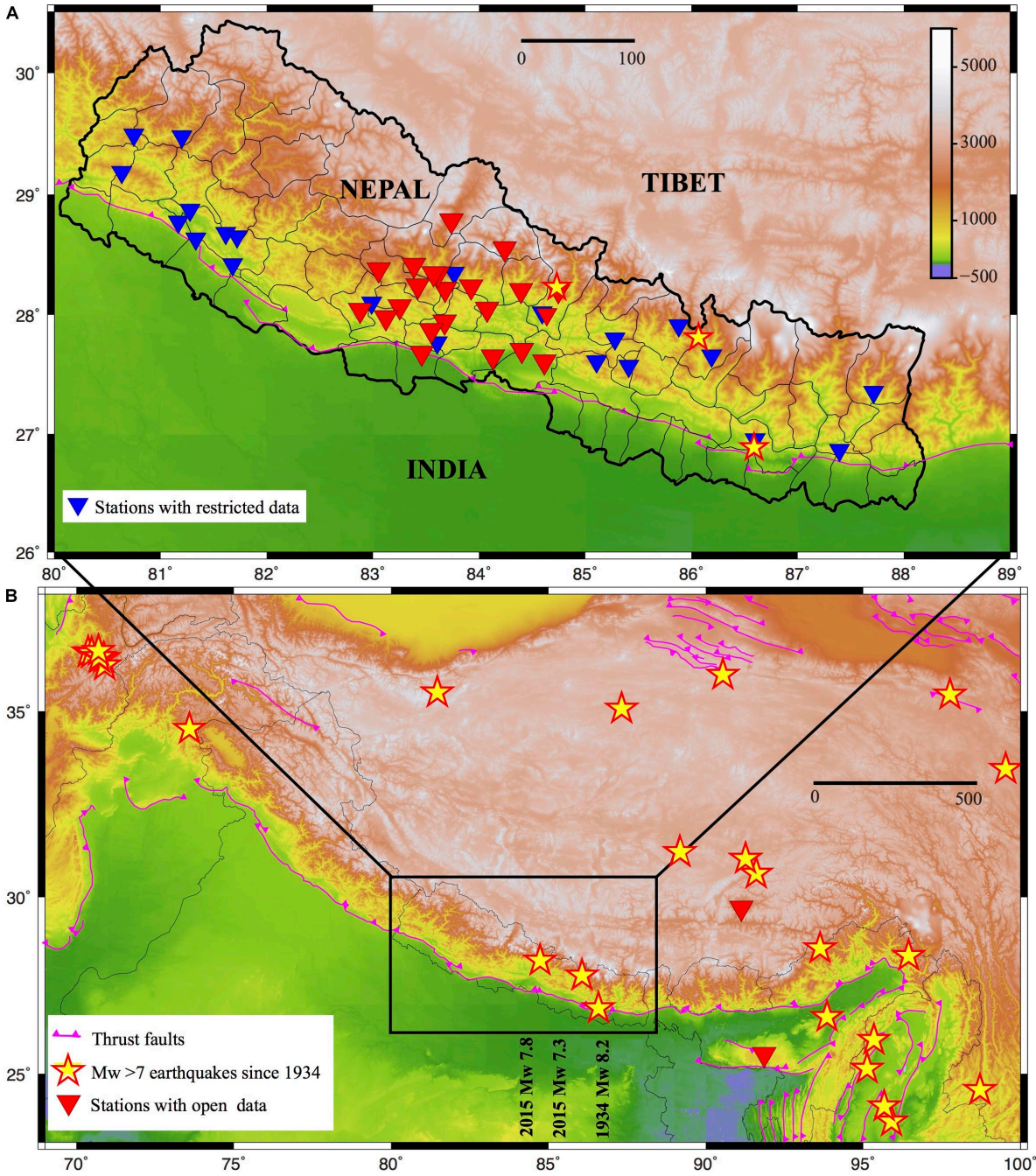
14 August 2021, 08:29 local time, Mw=7.2
2246 people killed, 12,763 injured, 329 missing, and affected more than 800,000 people, 650,000 of whom required emergency humanitarian assistance

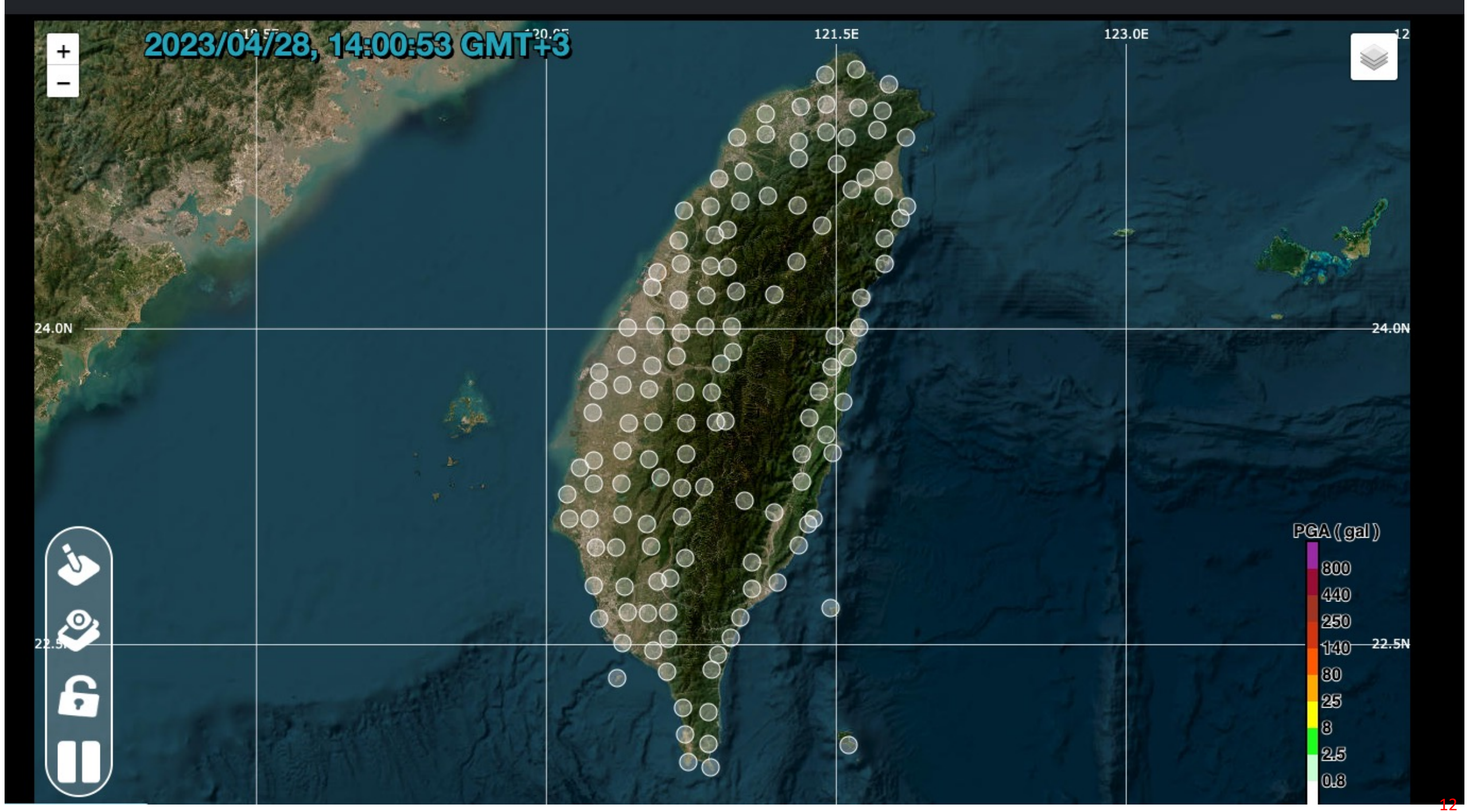
The seismometers allowed scientists to locate the over 100 aftershocks that followed the main quake. Machine learning applied to data obtained from the seismometer also enabled scientists to forecast aftershocks.
This is crucial, particularly in Haiti, where many buildings are not built to withstand earthquakes, for organizing emergency responses.
They also compared their results to the 2010 earthquake, showing that the fault rupture responsible for the previous earthquake was separated by a 60-km gap.

Map of RaspberryShake seismo-citizen stations operational in Haiti on February 24, 2021. The regions most affected by the earthquakes on January 12, 2010 and August 14, 2021 are indicated by yellow ellipses. *Credit: Tohoku University*

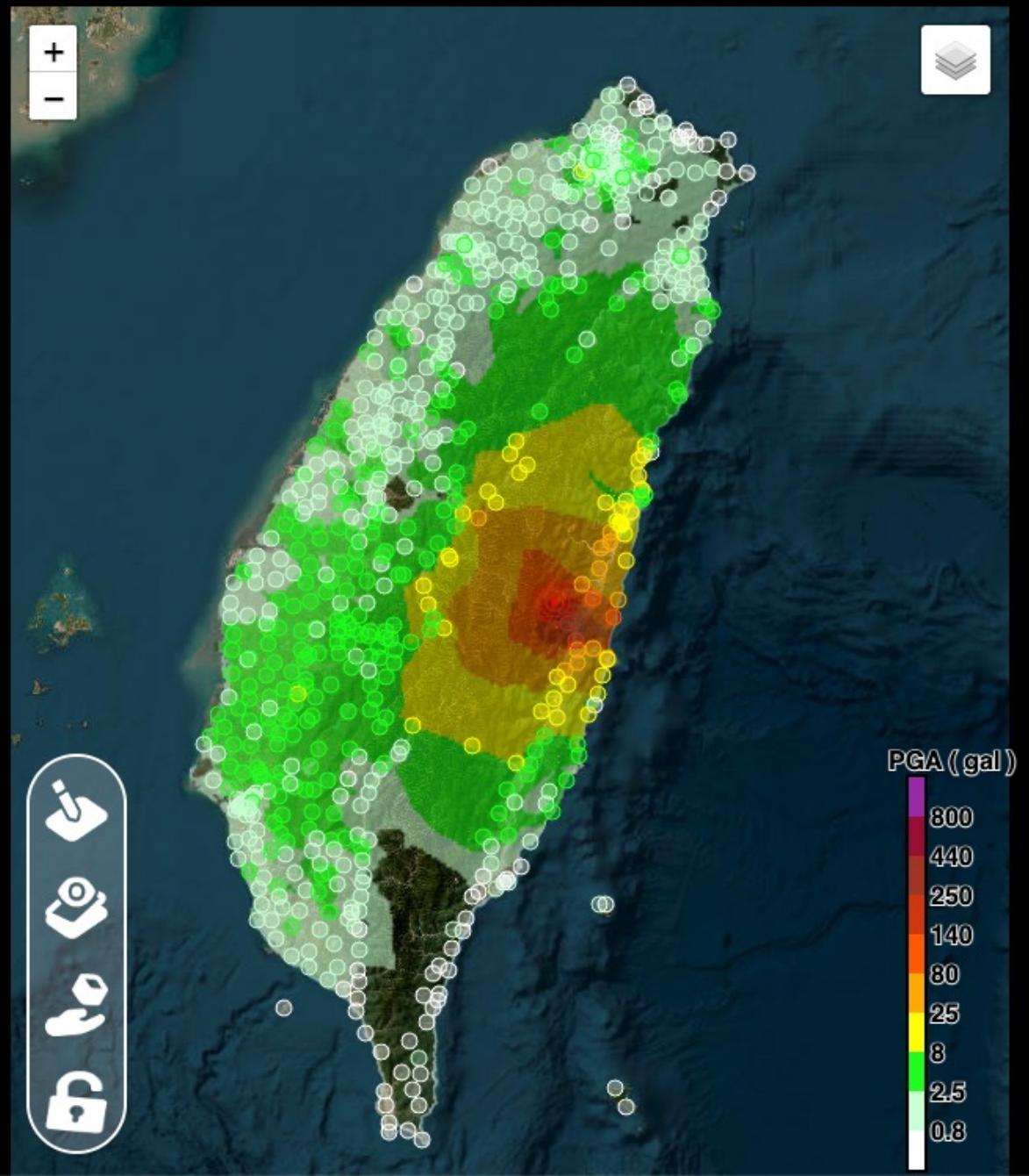
Seismology at School in Nepal: A Program for Educational and Citizen Seismology Through a Low-Cost Seismic Network

Subedi, S., et al., 2020, Frontiers




2023/04/28, 14:00:53 GMT+3
121.5E
123.0E
24.0N
22.5N
PGA (gal)
800
440
250
140
80
25
8
2.5
0.8

2023-03-21T01:45:19(UTC), Lat: 23.65°, Lon: 121.31°, Depth: 7.2 km, ML: 5.3



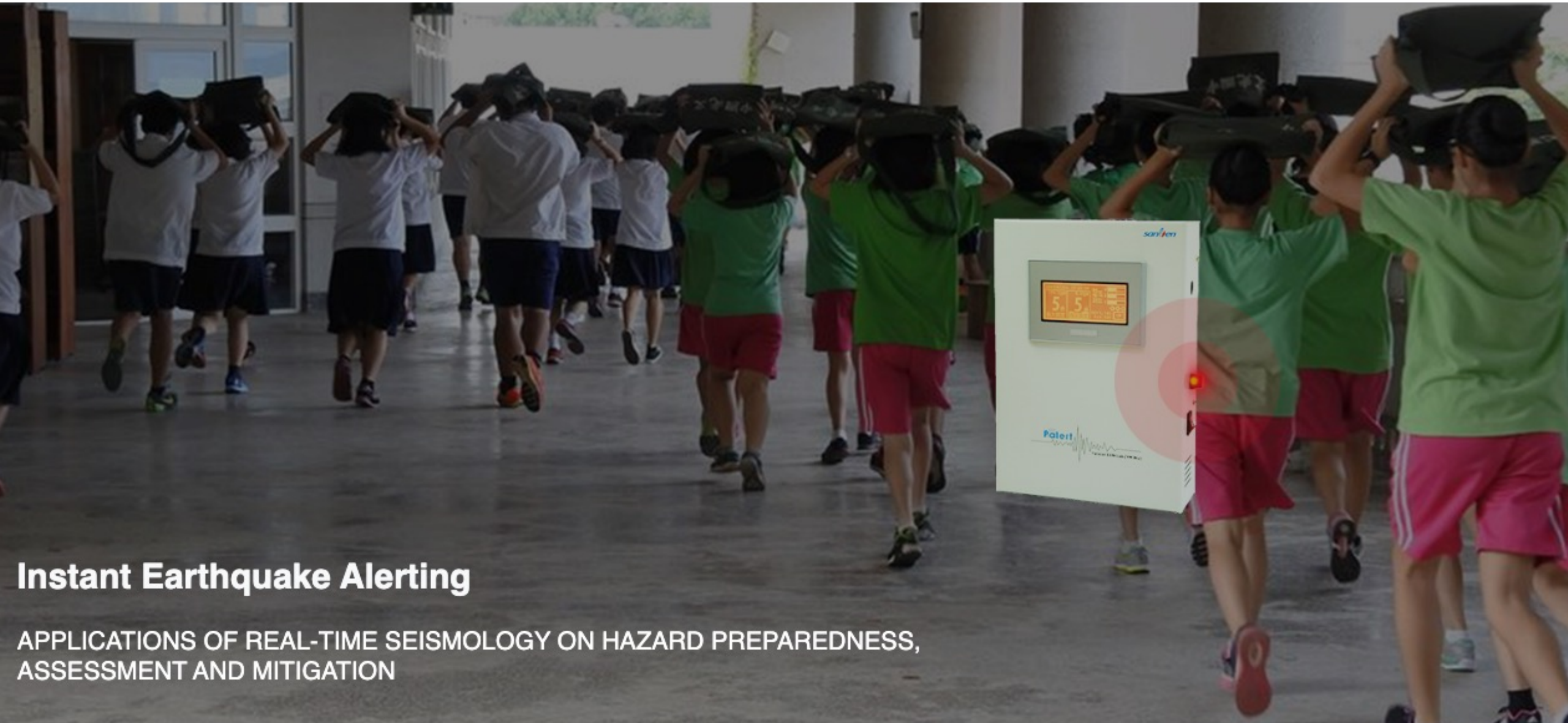
Search Table

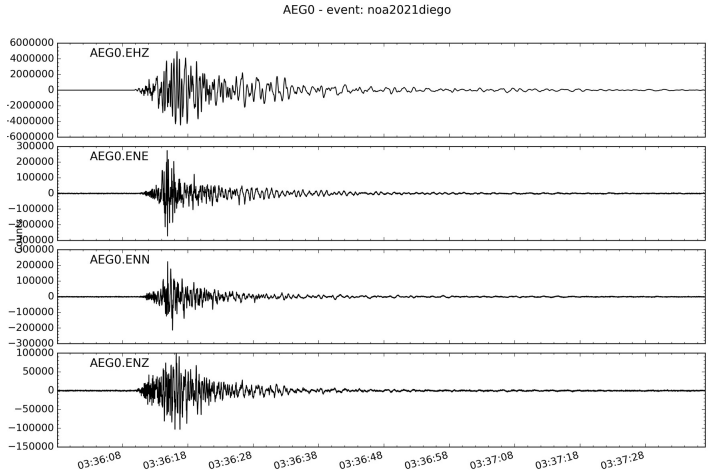
Download table data | Download SAC data

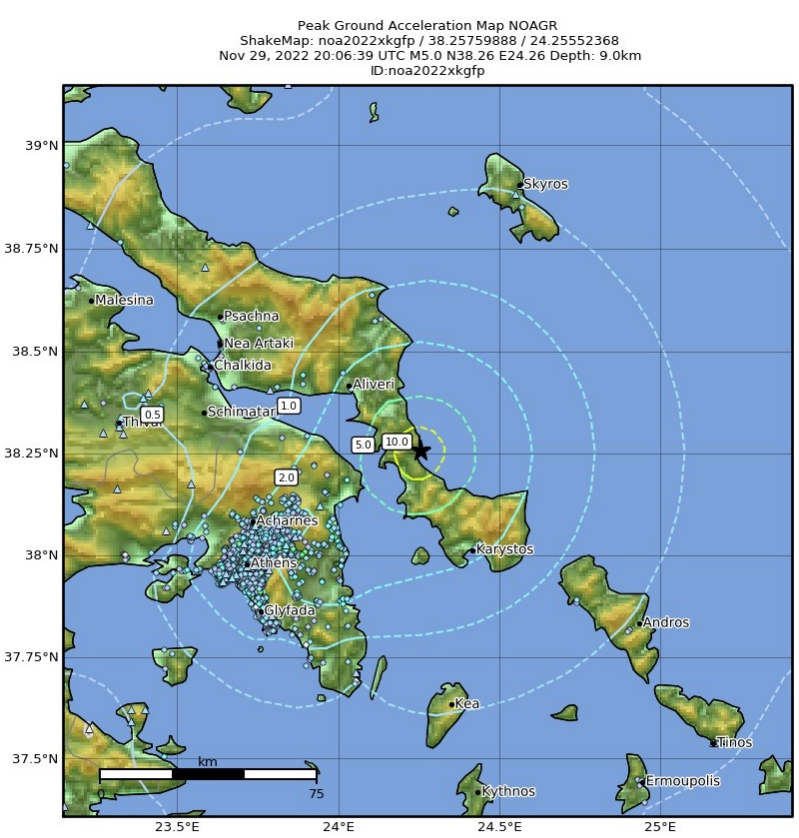
Station	PGA (gal)	PGV (cm/s)	Az.	Dist. (km)	Latitude	Lo
W48E	1.78	0.14229	330.92	115.14	24.5575	
W48D	7.18	0.20047	280.05	54.51	23.7350	
W48C	2.76	0.14464	284.83	63.06	23.7946	
W48B	1.26	0.14049	305.08	75.76	24.0419	
W48A	0.97	0.10346	310.71	86.41	24.1575	
W47F	1.01	0.10527	354.20	126.86	24.7895	
W47E	2.26	0.20930	352.57	135.94	24.8669	
W47D	0.89	0.13945	346.78	142.39	24.9011	
W47C	1.44	0.16345	347.28	124.39	24.7453	
W47B	4.36	0.16820	0.86	111.40	24.6557	

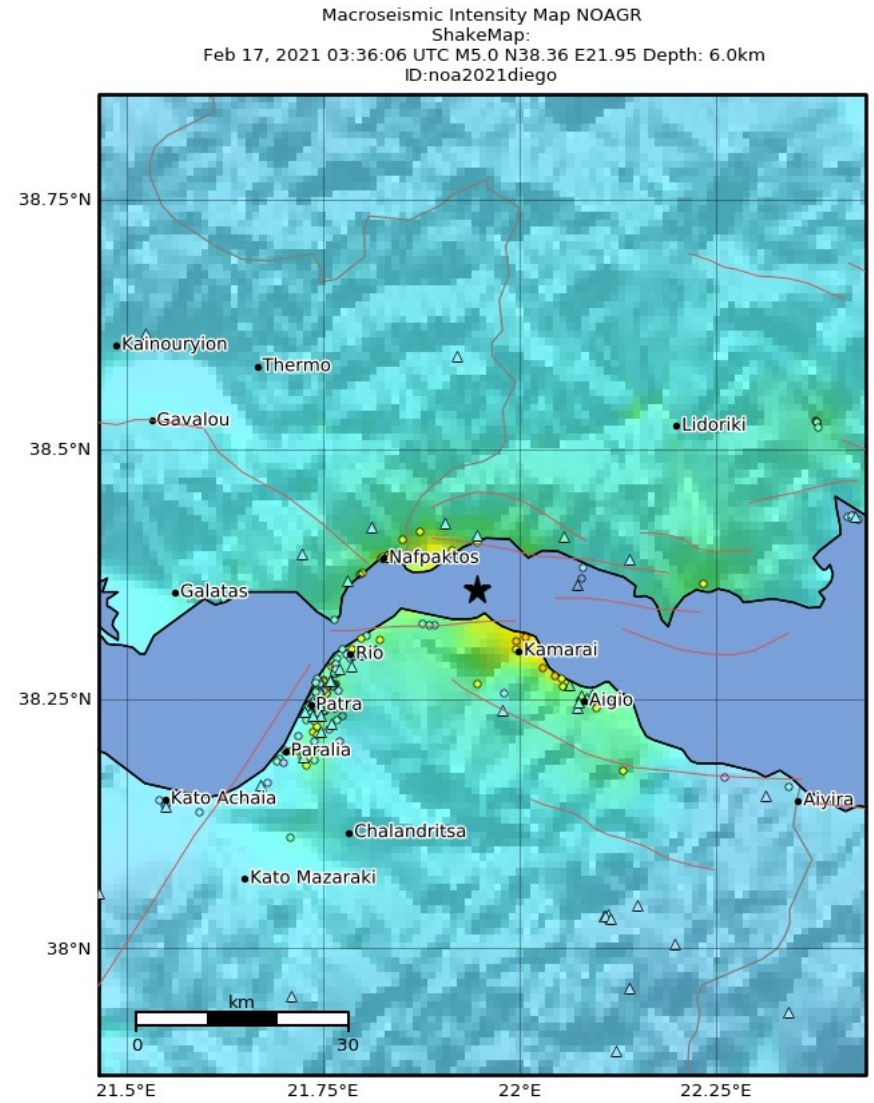
Table row color: data incomplete
data incomplete

Total : 722


Instant Earthquake Alerting
APPLICATIONS OF REAL-TIME SEISMOLOGY ON HAZARD PREPAREDNESS,
ASSESSMENT AND MITIGATION







Ο ΚΑΙΡΟΣ

ΤΟ ΔΕΛΤΙΟΝ ΤΟΥ ΑΣΤΕΡΟΣΚΟΠΕΙΟΥ

Βαρόμετρον

Αἱ ὑψηλαὶ πιέσεις αἱ κατέχουσαι προχθὲς τὴν Γαλλίαν χωρήσασαι πρὸς Α. κατέλαβον προχθὲς καὶ μέρος τῆς κεντρικῆς Εὐρώπης. Ἐν Ἑλλάδι ἡ βαρομετρικὴ πίεσις παρέμεινεν ἡ αὐτή, ὀλίγον χαμηλωτέρα καὶ κανονική. Χθὲς τὴν 8ην π. μ. βαρόμετρον ἐν Ἀθήναις 758,8.

Θερμόμετρον

Ἡ θερμοκρασία ἀξακολουθεῖ νὰ παραμένῃ εἰσέτι ὑψηλή. — Θερμοκρασία χθὲς τὴν 8 π.μ. ἐν Ἀθήναις 27,8, Καλάμαις 27,9, Ἄρτῃ 28,4, Ἄνδρῳ 31,9, Κυθήροις 27,6, Σπάρτῃ 31,8, Ζακύνθῳ 30,1, Ἀργοστολίῳ 28,2, Ρώμῃ 22.0, Βυκορεστίῳ 22,2. Βελιγραδίῳ 17,3, Παρισίοις 10,9.—Ἡ μεγίστη ἐν Ἀθήναις 34,7 καὶ ἡ ἐλαχίστη 25,2. 29/07/1902

Οὐρανὸς τὸ πλεῖστον αἴθριος.

Ἄνεμοι γενικῶς μεταβλητοὶ μέτριοι—ἀσθενεῖς. Θάλασσα τεταραγμένη ὀλίγον.

Ὑγρασία ἐν Ἀθήναις ὀλίγη (38).

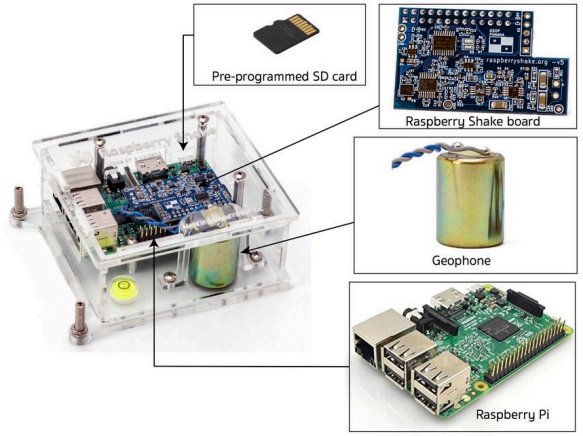
Σεισμός

Χθὲς τῇ 4η καὶ 55' π. μ. ἐγένετο ἐν Κερκύρᾳ ἀσθενὴς δόνησις σεισμοῦ διευθυνομένη ἀπὸ ΝΑ πρὸς ΒΑ.

23/03/1905

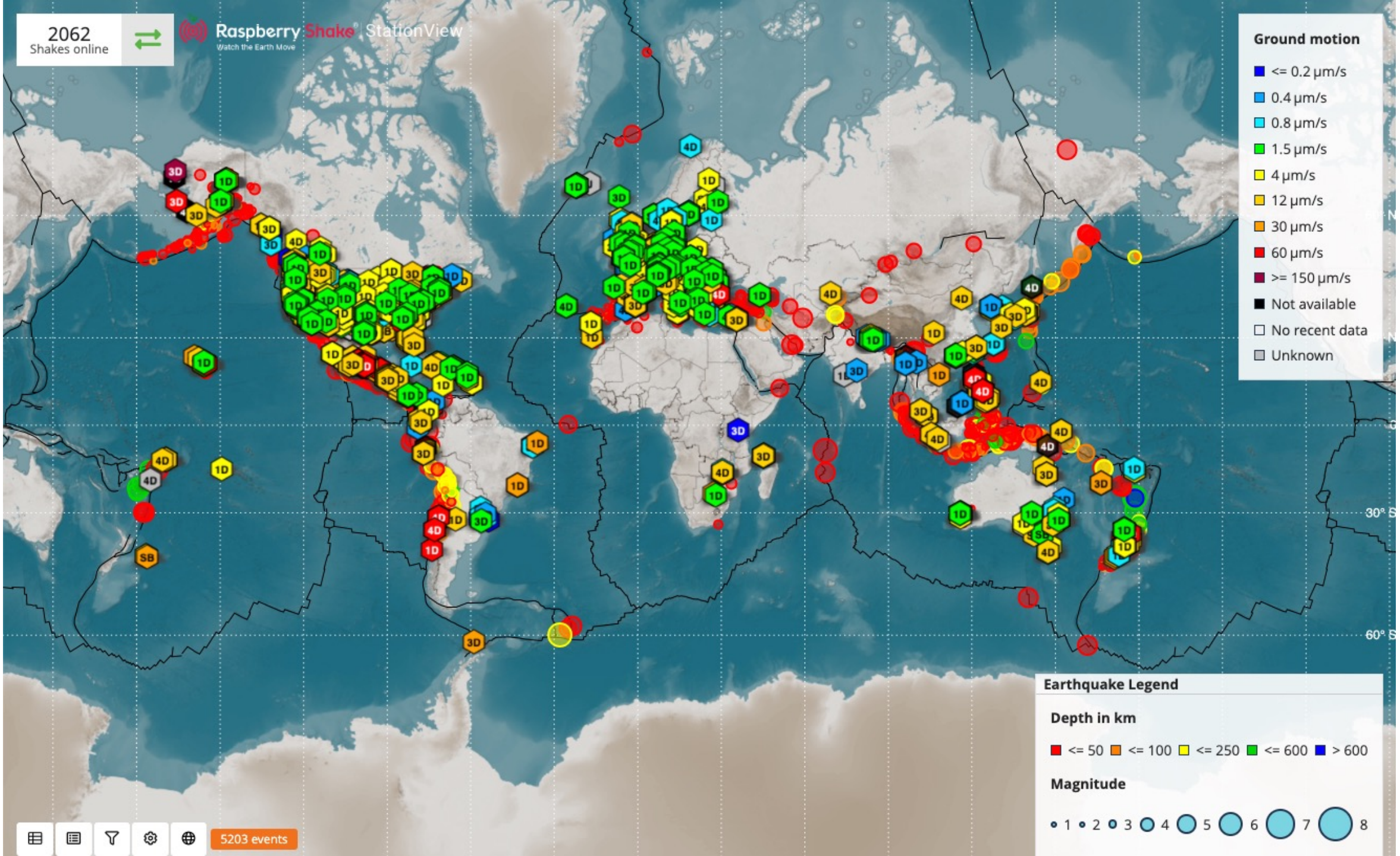
ΣΕΙΣΜΟΙ

Χθὲς τῇ 2 34' 8'' ἐν Ἀθήναις ἐγένετο μικροσεισμικὴ δόνησις σημειωθεῖσα ὑπὸ τοῦ σεισμογράφου τοῦ Ἀστεροσκοπείου. Ἑτέρα δόνησις ἐπίσης μικροσεισμικὴ ἐγένετο τῇ 2 41' 15'' π. μ. σημειωθεῖσα καὶ αὕτη ὑπὸ τοῦ σεισμογράφου. Ἕτεραι δύο μικροσεισμικαὶ δονήσεις ἐγένοντο τῇ 12η 1' 49'' καὶ 12 36' 40''.



SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
DAMAGE	None	None	None	Very light	Light	Moderate	Moderate/heavy	Heavy	Very heavy
PGA(%g)	<0.0464	0.297	2.76	6.2	11.5	21.5	40.1	74.7	>139
PGV(cm/s)	<0.0215	0.135	1.41	4.65	9.64	20	41.4	85.8	>178
INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Scale based on Worden et al. (2012)
Version 1: Processed 2021-04-05T23:22:20Z
Seismic Instrument
Reported Intensity
Epicenter


2062
Shakes online
Raspberry Shake StationView
Watch the Earth Move
Ground motion
<= 0.2 µm/s
0.4 µm/s
0.8 µm/s
1.5 µm/s
4 µm/s
12 µm/s
30 µm/s
60 µm/s
>= 150 µm/s
Not available
No recent data
Unknown
30° S
60° S
Earthquake Legend
Depth in km
<= 50
<= 100
<= 250
<= 600
> 600
Magnitude
1
2
3
4
5
6
7
8
5203 events