University of Trieste
Department of Mathematics and Geosciences

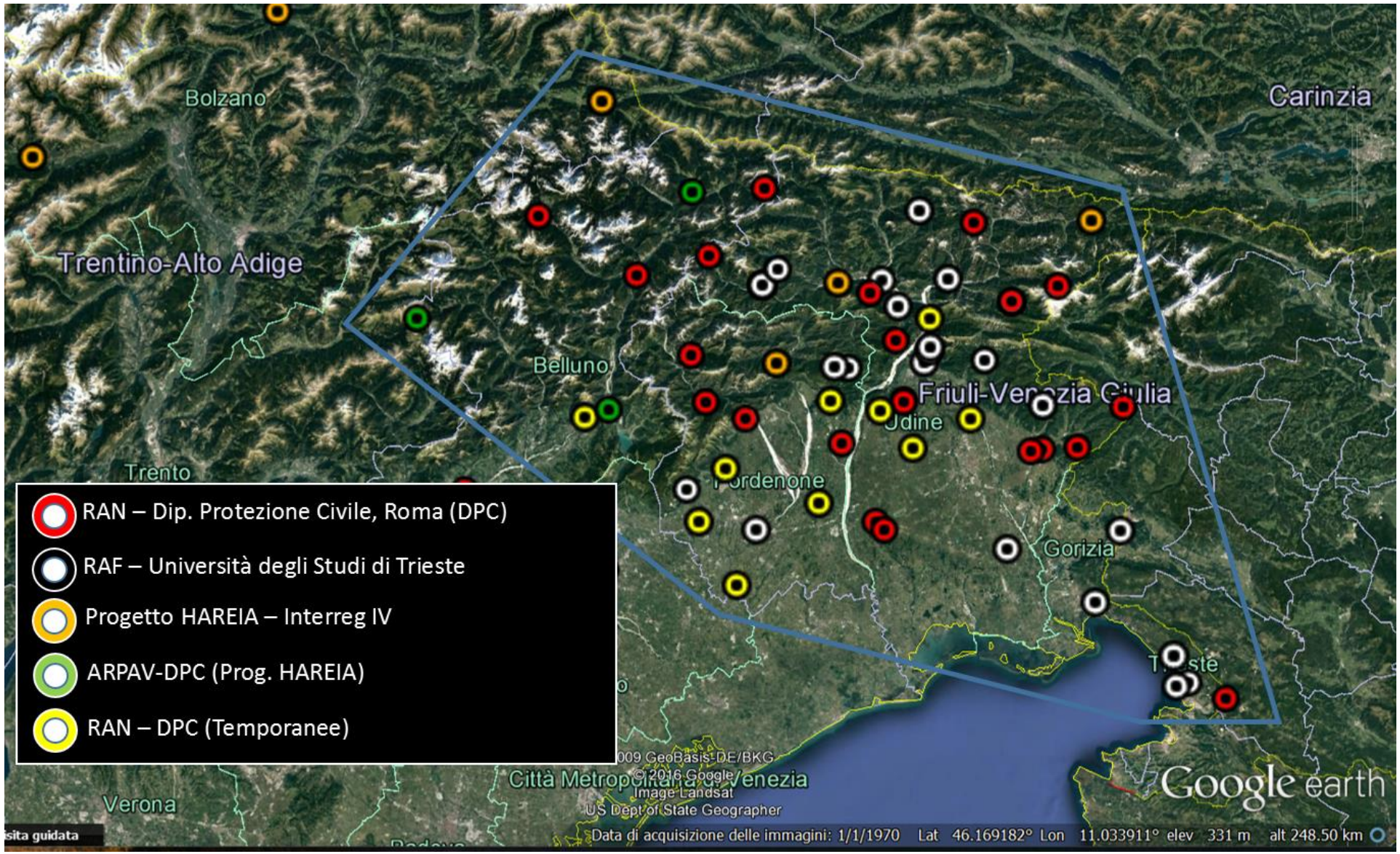
European Antelope User Group Meeting 2019

May 28-30, 2019
Taormina, Italy

Ground motion data analysis in Antelope

SeisRaM group
Department of Mathematics and Geosciences – University of Trieste

SeisRaM

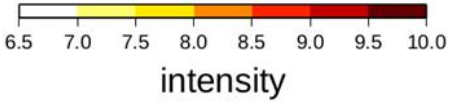

Bolzano
Carinzia
Trentino-Alto Adige
Belluno
Friuli-Venezia Giulia
Udine
Trento
Pordenone
Gorizia
Trieste
Città Metropolitana di Venezia
Verona
RAN – Dip. Protezione Civile, Roma (DPC)
RAF – Università degli Studi di Trieste
Progetto HAREIA – Interreg IV
ARPAV-DPC (Prog. HAREIA)
RAN – DPC (Temporanee)
©2009 GeoBasis-DE/BKG
©2016 Google
Image Landsat
US Dept of State Geographer
Google earth
Data di acquisizione delle immagini: 1/1/1970 Lat 46.169182° Lon 11.033911° elev 331 m alt 248.50 km

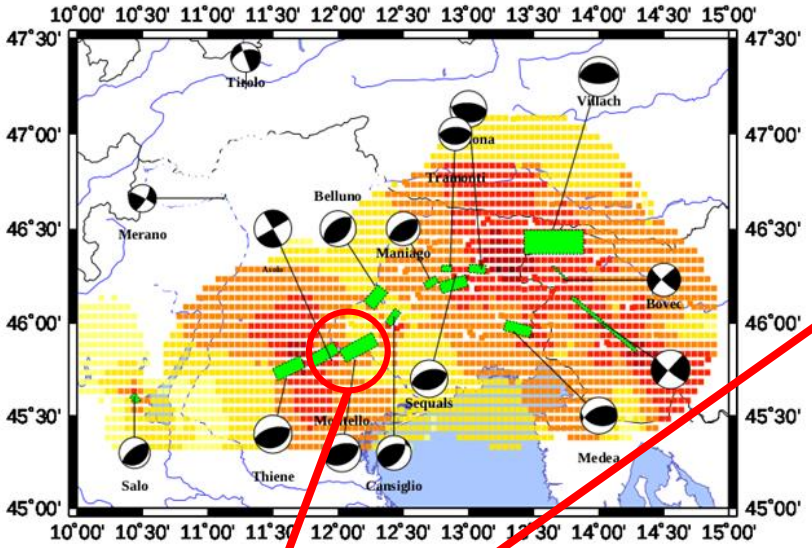
Interreg
Italia-Österreich
European Regional Development Fund

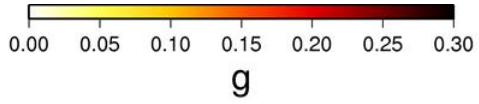
EUROPEAN UNION

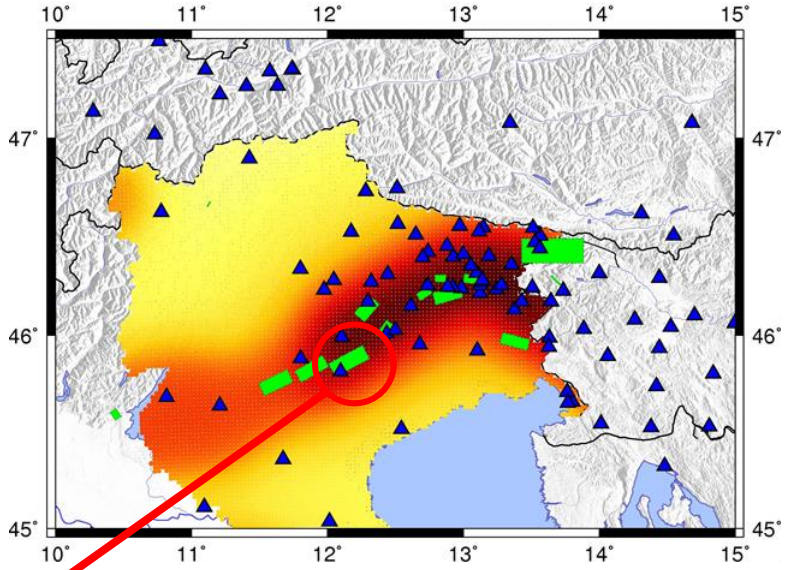
ARMONIA

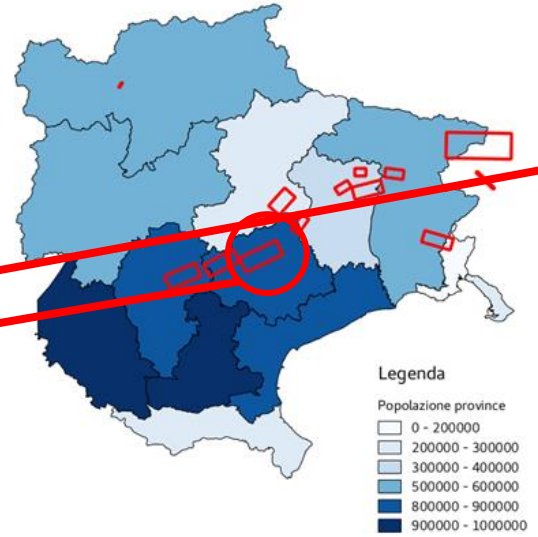
SeisRaM

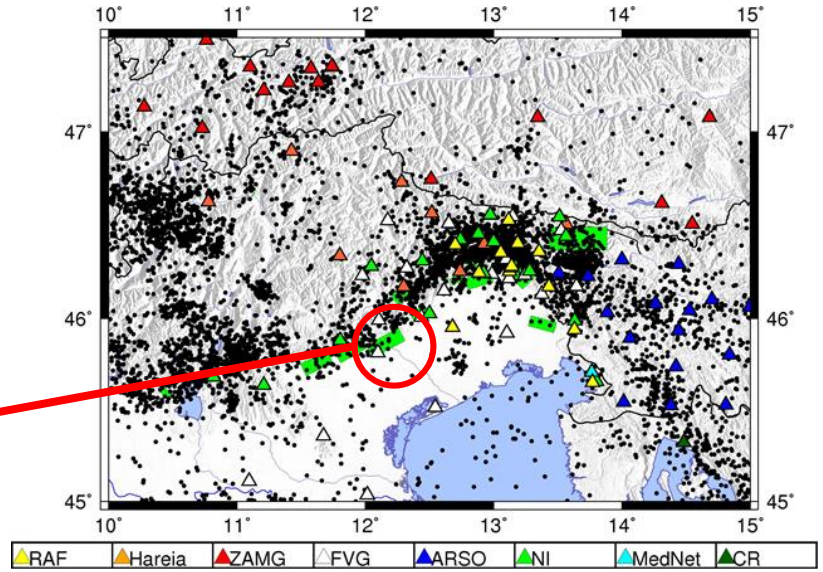












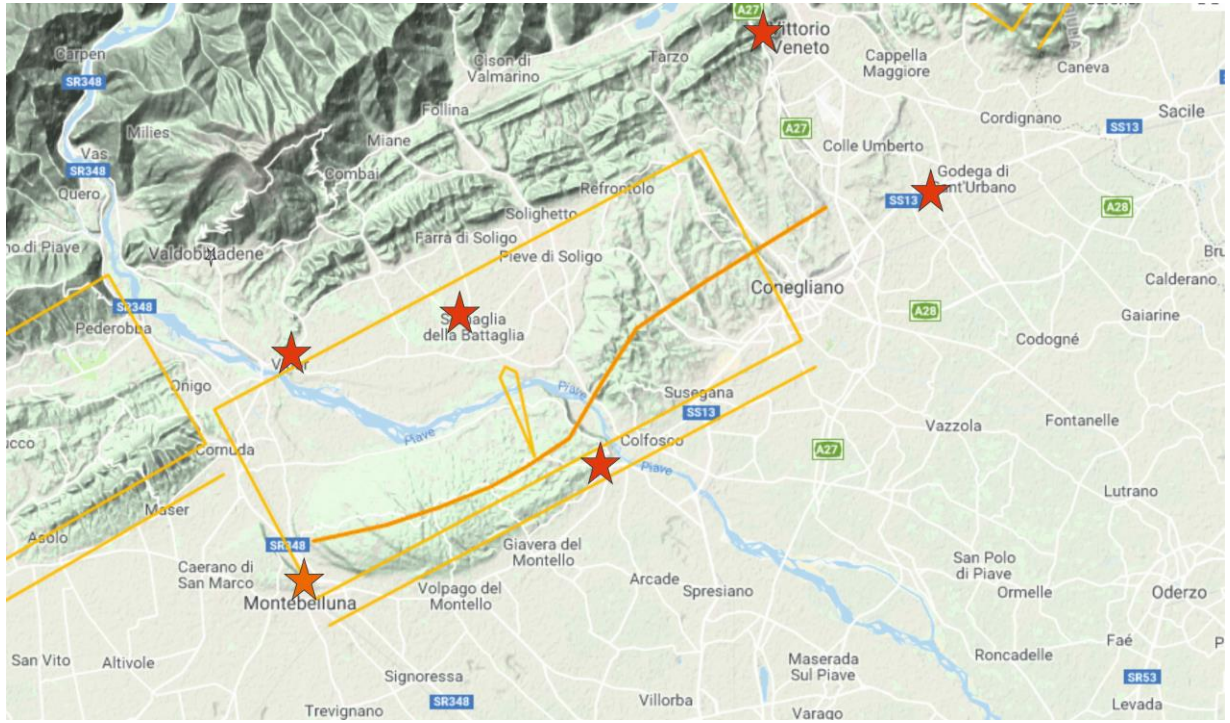
Montello fault

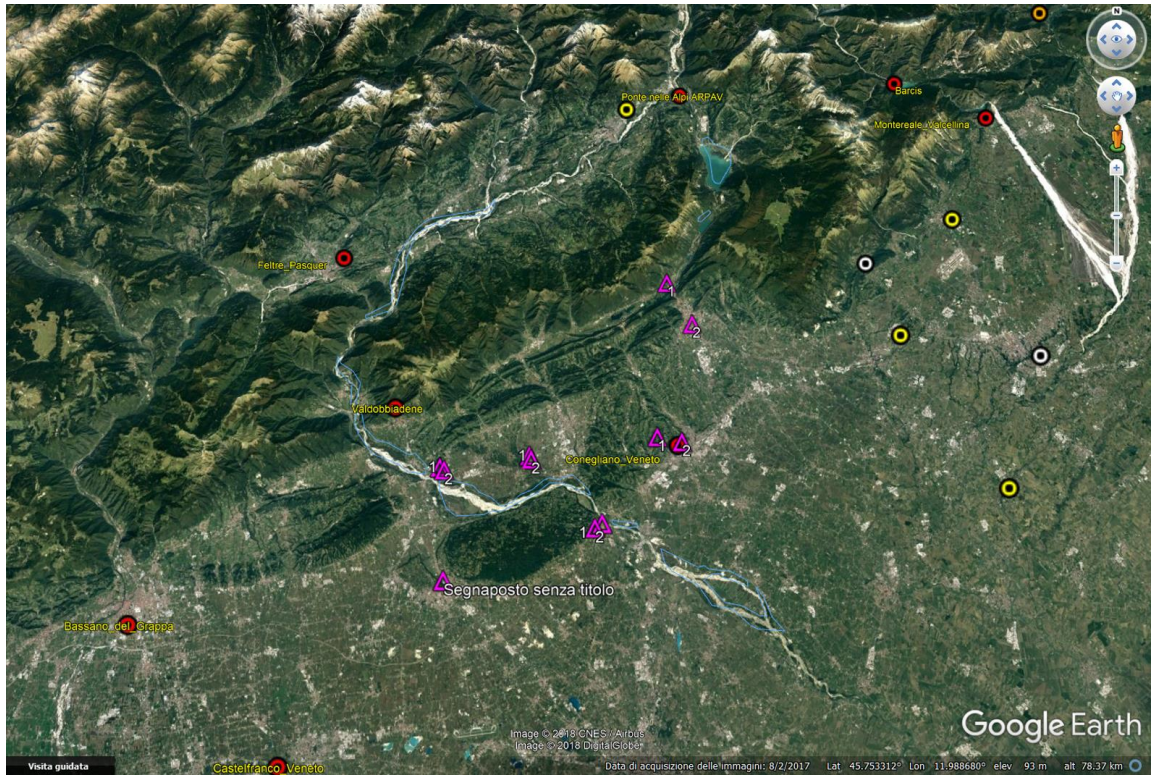
Interreg
Italia-Österreich
European Regional Development Fund

EUROPEAN UNION

SeisRaM

ARMONIA





SeisRaM

The SeisRaM group of Trieste Univrsity developed an automated routine in Antelope Software environment, that determines in near time seismic source parameters (Gallo et al. 2014, Costa et al. 2014) and strong motion parameters from recorded waveforms. These parameters are computed within *few minutes* after the earthquakes and rapidly revised.

This automatic routine, over time, has been optimized improving the quality of results and it is running at Italian Civil Department, at Italian strong motion network data center.

PGA, PGV, PGD, PSA03, PSA10, PSA30, Housner, Arias, RMSA, duration, intensity of zero crossing, Saragoni index, damage factor,…

dbgm (C code)

db.chanpos

db.wfdisc
db.origin
db.event
db.netmag

orb2db
orb2wf

db tables

Select origin

Standard Component Orientation

yes

no

Channels rotation

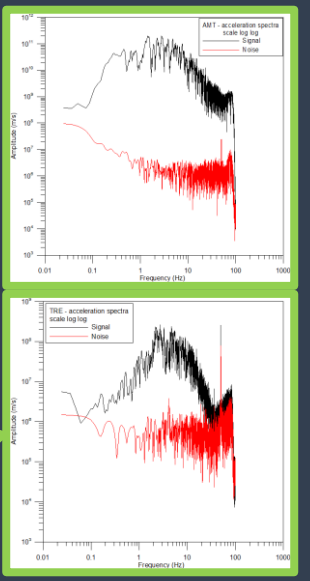
Select N,E,Z component

Ml > magmin
Dismin < dist < distmax

reject

no

f2 > f1
f1 < fmin, f2 > fmax



db.arrival
db.assoc

Extract noise and S-wave window

Apply rmean , detrend, d2 instrumental response

Define low-high pass corner frequencies (f1, f2)

Apply bandpass Butterworth filter

db.calibration
db.site
db.sensor
db.instrument

Compute instrument response

Compute displacement, velocity, acceleration Fourier spectra

Compute displacement, velocity, acceleration waveforms

Compute response spectra, ground motion parameters *

db.gmp

* PGA, PGV, PGD, EPA, PSA03, PSA10, PSA30, Housner, Arias, RMSA, duration, intensity of zero crossing, Saragoni index, damage factor,...

db tables

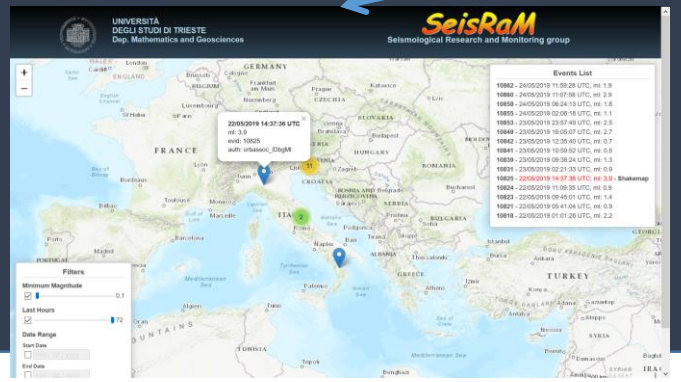
db.origin

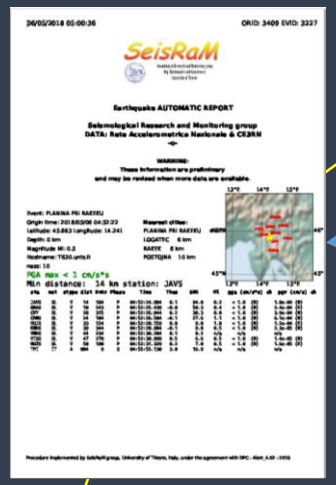
DMG database

UTS.trigger

UTS.proc
UTS.sms
wfmax
Alert
dbgm
dbgmw
REPO
db2shake.py
db2GMPE
db2kml
db2json.py

Web-gis





python

Alert

C

dbgmw

dbgm

python- gmt

REPO

db2shake

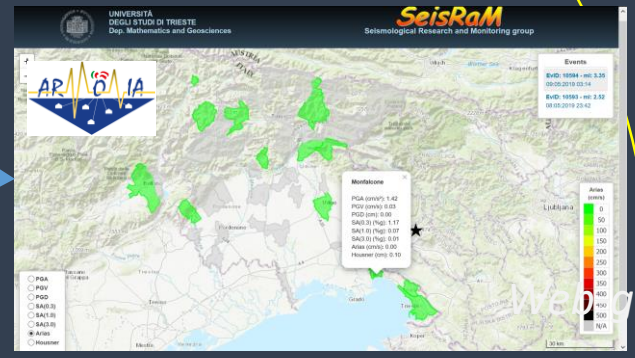
python

python

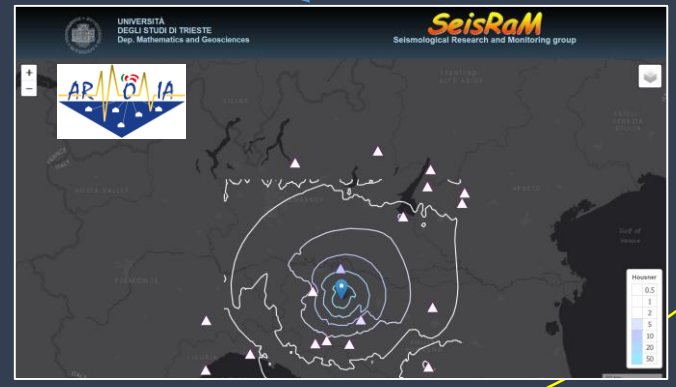
db2json

Web-gis

Web-gis



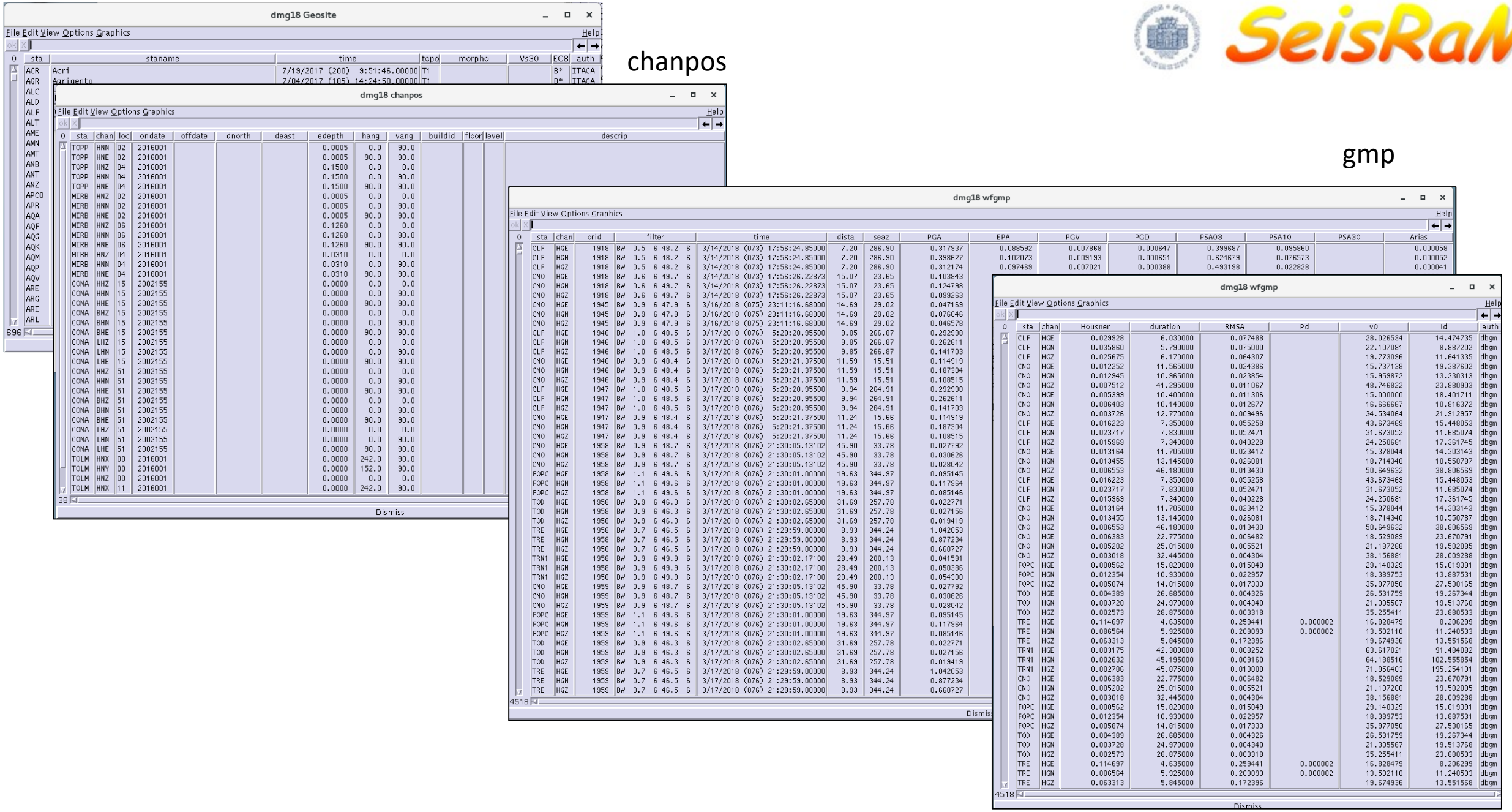
Web-gis



geosite

chanpos

gmp



PROTEZIONE CIVILE
Presidenza del Consiglio dei Ministri
Dipartimento della Protezione Civile

Automatic, real time report for Civil Defence

SeisRaM

03/04/2014 12:05:11 ORID: 618 EVID: 389

PROTEZIONE CIVILE
Presidenza del Consiglio dei Ministri
Dipartimento della Protezione Civile

Earthquake AUTOMATIC REPORT

Dipartimento della Protezione Civile - Rome - Italy
Rete Accelerometrica Nazionale
RAN

WARNING:
These information are preliminary
and may be revised when more data are available.

Event: NORTHERN_ITALY
Origin time: 2012/05/29 07:00:03
Latitude: 44.851 Longitude: 11.086
Magnitude Ml: 5.8
AGENCY: INGV

Seismic Moment: 1.13e+18 Nm
Mw: 5.8
AGENCY: UniTS

Records analyzed by procedure: 197
Selected limits: max distance=150. km min PGA= 0.1 cm/s*s
min PGA to show response spectra= 0.1 cm/s*s
Records inside the selected limits: 185 response spectra inside the limits: 185

Nearest station: MRN distance: 3.81 km
HGZ - PGA=895.78 cm/s*s, PGV=21.64 cm/s

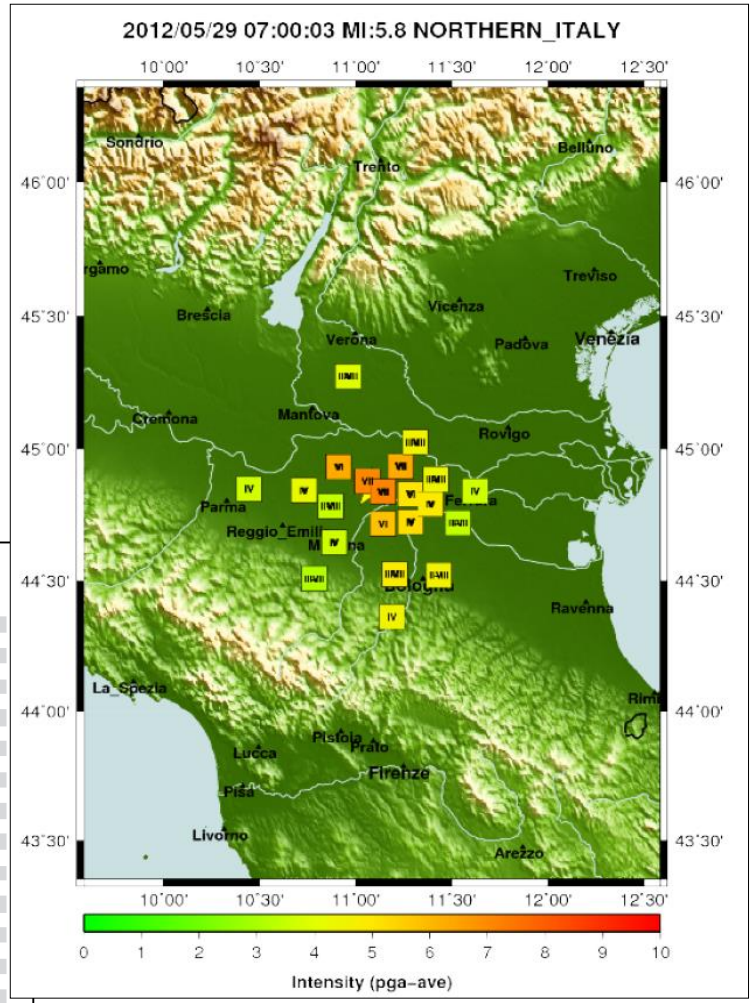
Procedure implemented by SeisRaM group, University of Trieste, Italy - ver: SPT_1.24 - 2014 - costa@units.it

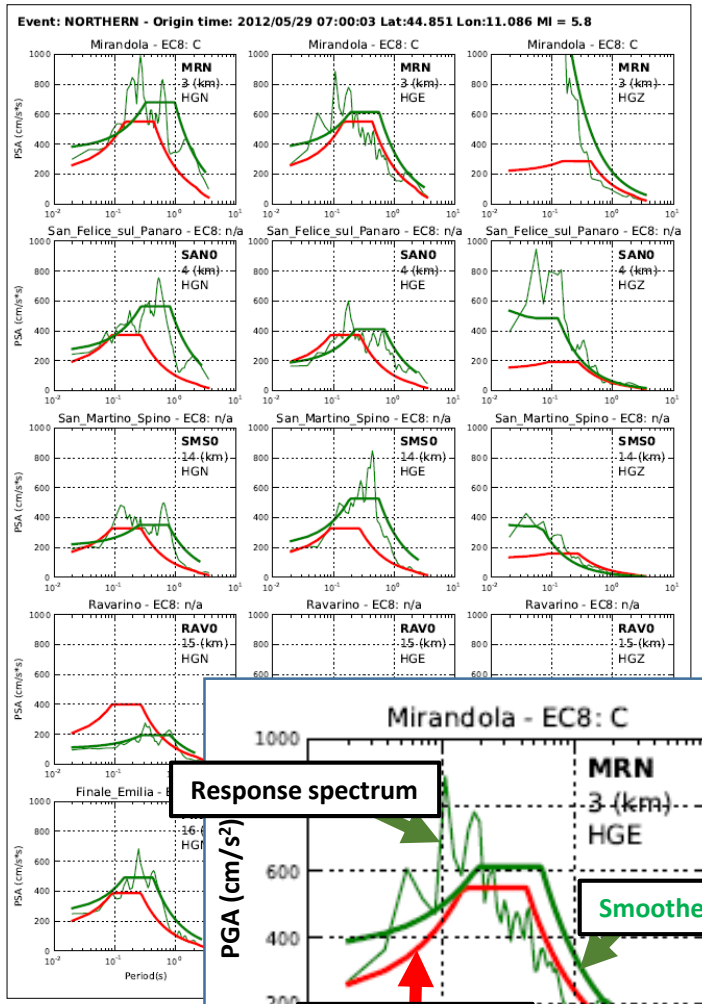
SeisRaM **Event: KNEZAK - Origin time: 2014/04/22 08:58:27 Lat:45.633 Lon:14.258 Ml = 4.7 Agency: UniTS**
Seismic moment: 2.670e+16 Nm - Mw = 4.5 Agency: UniTS

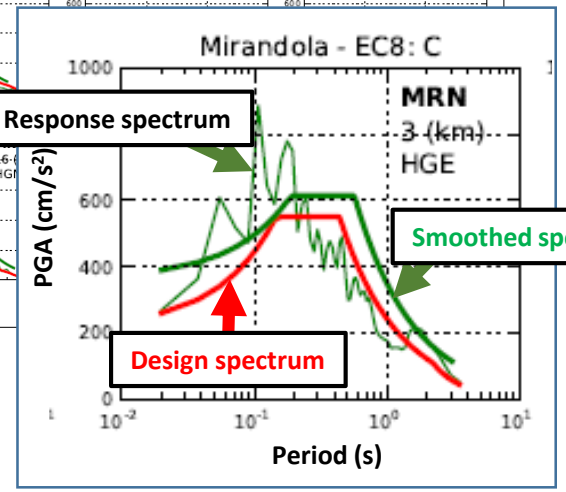
sta	chan	dista	filter	PGA	EPA	PGV	PGD	PSA03	PSA10	PSA30	EC8	location
		km	Hz	cm/s*s	cm/s*s	cm/s	cm	cm/s*s	cm/s*s	cm/s*s		
KNDS	HHN	15	0.1-50.0	37.72	18.21	0.82	0.05	46.81	3.25	0.34	na	Knezji Dol, SL
KNDS	HHE	15	0.1-50.0	23.92	13.69	0.69	0.06	27.62	3.59	0.28	na	Knezji Dol, SL
KNDS	HHZ	15	0.1-50.0	17.14	6.61	0.33	0.02	15.04	0.78	0.11	na	Knezji Dol, SL
CEY	HHN	17	0.1-50.0	47.72	10.45	0.75	0.05	17.87	3.40	0.32	na	Cerknica, SL
CEY	HHE	17	0.1-50.0	30.33	9.38	0.70	0.04	11.35	1.94	0.22	na	Cerknica, SL
CEY	HHZ	17	0.1-50.0	17.83	4.48	0.27	0.02	9.18	0.86	0.12	na	Cerknica, SL
SKDS	HGN	21	0.1-50.0	30.76	9.61	0.62	0.04	15.55	2.15	0.20	na	Skadanscina, SL
SKDS	HGE	21	0.1-50.0	19.71	7.32	0.44	0.03	14.50	1.60	0.14	na	Skadanscina, SL
SKDS	HGZ	21	0.1-50.0	13.09	4.50	0.27	0.02	10.94	0.76	0.10	na	Skadanscina, SL
SKDS	HHN	21	0.2-50.0	30.33	9.88	0.65	0.03	15.58	2.16	0.22	na	Skadanscina, SL
SKDS	HHE	21	0.2-50.0	21.62	7.46	0.43	0.02	14.51	1.65	0.16	na	Skadanscina, SL
SKDS	HHZ	21	0.1-50.0	13.35	4.49	0.27	0.02	10.97	0.77	0.10	na	Skadanscina, SL
JAVS	HHN	33	0.1-50.0	6.13	2.86	0.14	0.02	4.66	0.80	0.15	na	Javornik, SL
JAVS	HHE	33	0.1-50.0	11.36	6.15	0.31	0.03	10.40	1.63	0.20	na	Javornik, SL
JAVS	HHZ	33	0.1-50.0	4.70	2.64	0.12		5.09	0.64	0.05	na	Javornik, SL
DST2	HHN	36	0.1-47.0	7.46	4.97	0.27	0.02	9.90	1.04	0.12	A	DST-Trieste_station
DST2	HHE	36	0.1-46.4	9.09	4.13	0.20	0.01	8.00	0.61	0.10	A	DST-Trieste_station
DST2	HHZ	36	0.1-47.8	4.49	2.65	0.12		5.70	0.47	0.05	A	DST-Trieste_station
GBAS	HHN	37	0.1-50.0	3.23	1.26	0.07		2.35	0.33	0.05	na	Gornja Brezovica, SL
GBAS	HHE	37	0.1-50.0	3.71	1.43	0.07		3.31	0.40	0.03	na	Gornja Brezovica, SL
GBAS	HHZ	37	0.1-50.0	2.43	0.96	0.06		1.56	0.38	0.03	na	Gornja Brezovica, SL
TRI	HHN	39	0.1-47.3	12.38	1.97	0.15		2.33	0.46	0.05	A	TRI-Trieste_station
TRI	HHE	39	0.1-45.6	13.66	3.60	0.19		4.30	0.31	0.08	A	TRI-Trieste_station
TRI	HHZ	39	0.1-47.5	31.18	4.24	0.34		5.12	0.30	0.08	A	TRI-Trieste_station
GBRS	HHN	45	0.1-50.0	11.89	3.11	0.20		2.86	0.56	0.06	na	Gornja Briga, SL
GBRS	HHE	45	0.1-50.0	15.31	3.81	0.25		4.30	0.46	0.07	na	Gornja Briga, SL
GBRS	HHZ	45	0.1-50.0	4.42	1.12	0.07		1.75	0.47	0.06	na	Gornja Briga, SL
VISS	HHN	49	0.1-50.0	3.78	2.32	0.13	0.01	4.22	1.16	0.09	na	Visnje, SL
VISS	HHE	49	0.1-50.0	3.68	2.00	0.10		2.71	0.69	0.05	na	Visnje, SL

dista = epicentral distance
filter = automatic band pass butterworth filter
EC8 = site classification (Eurocode from ITACA)

PGA,PGV,PGD = peak ground acceleration, velocity and displacement
EPA = effective ground acceleration (Kramer, 1996)
PSA03,PSA10,PSA30 = spectral acceleration (0.3, 1.0, 3.0 sec)





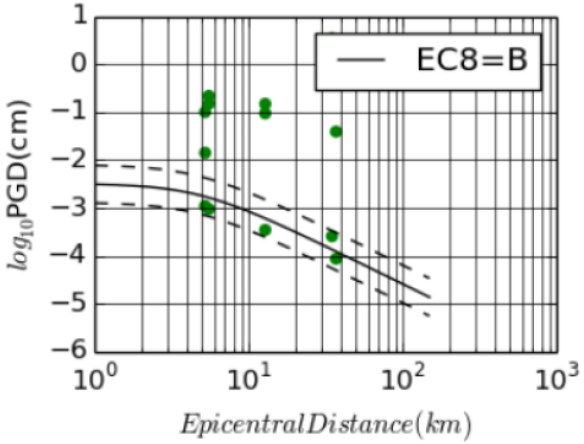


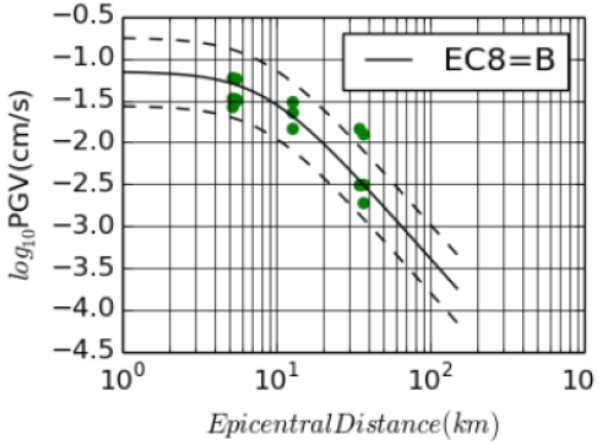
PROTEZIONE CIVILE
Presidenza del Consiglio dei Ministri
Dipartimento della Protezione Civile

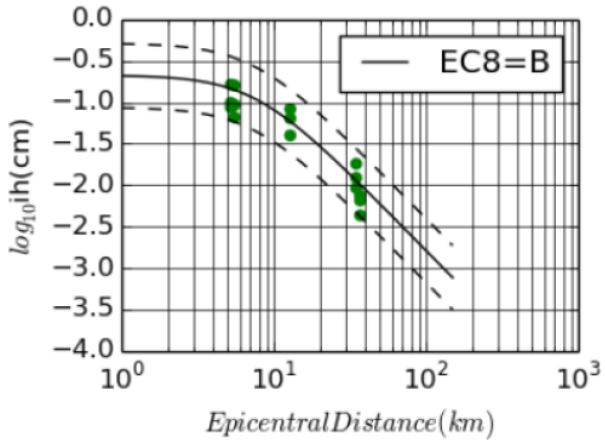
Automatic, real time report for Civil Defence

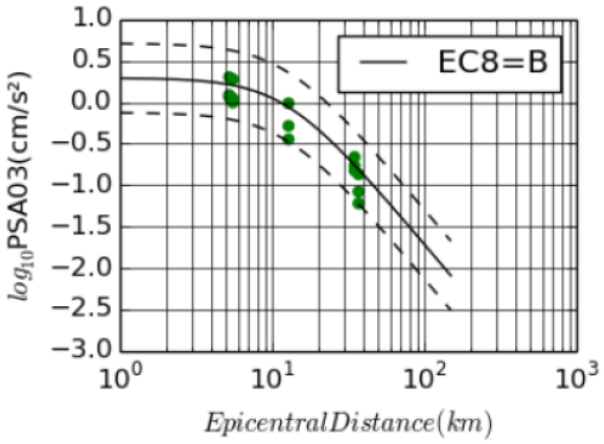
GMPE

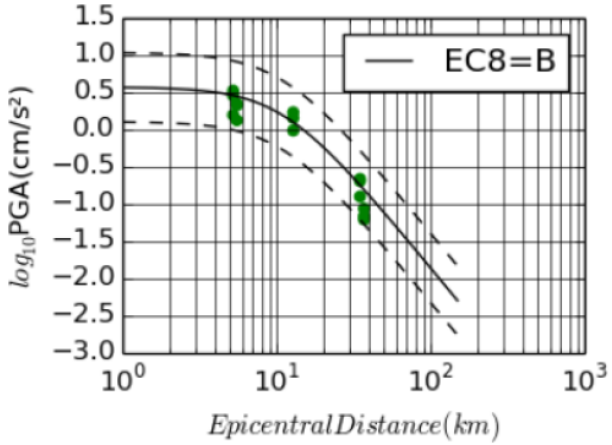
SeisRaM

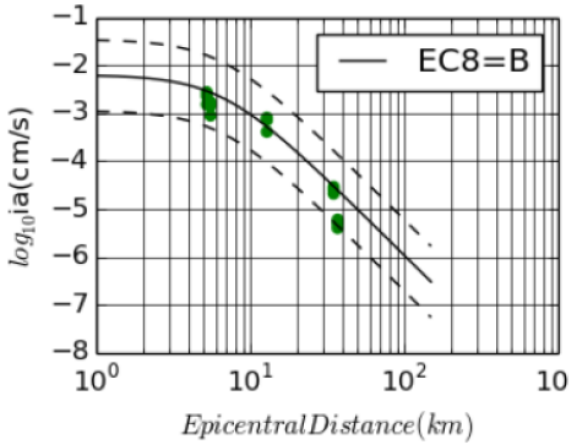


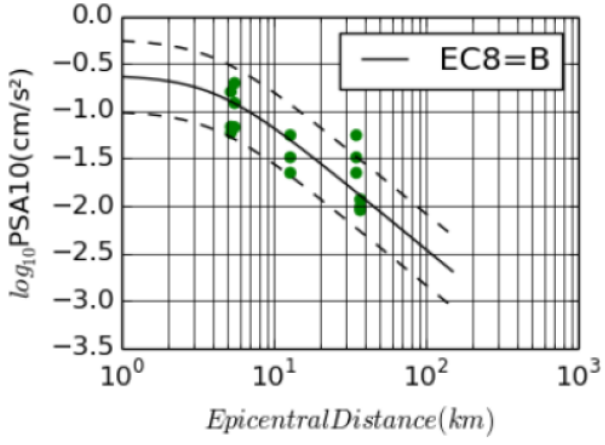


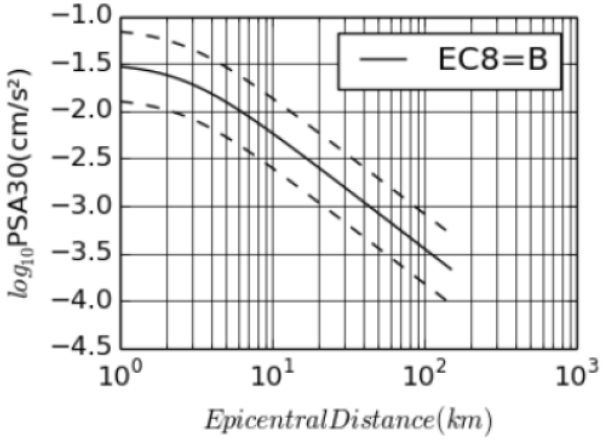






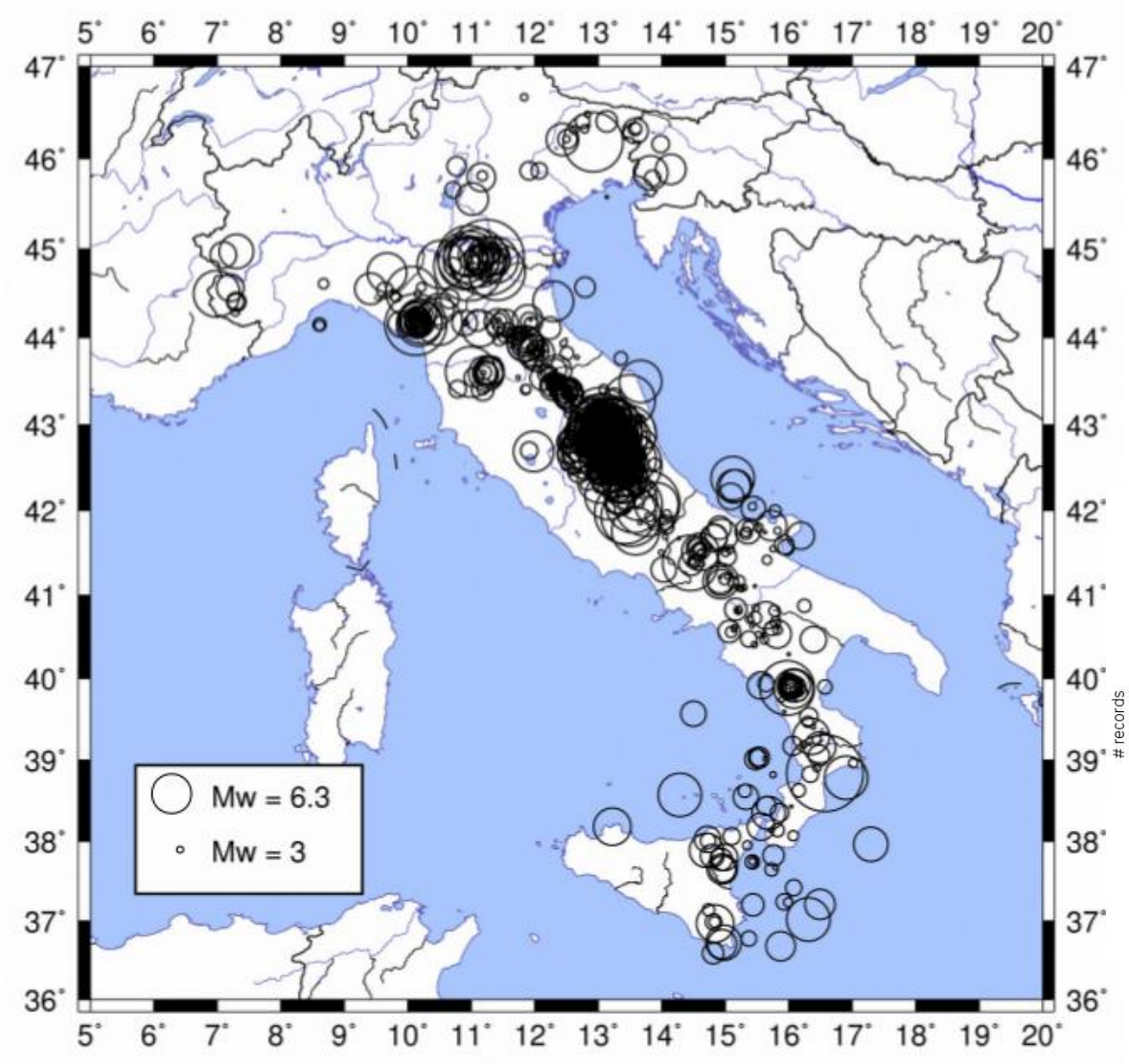






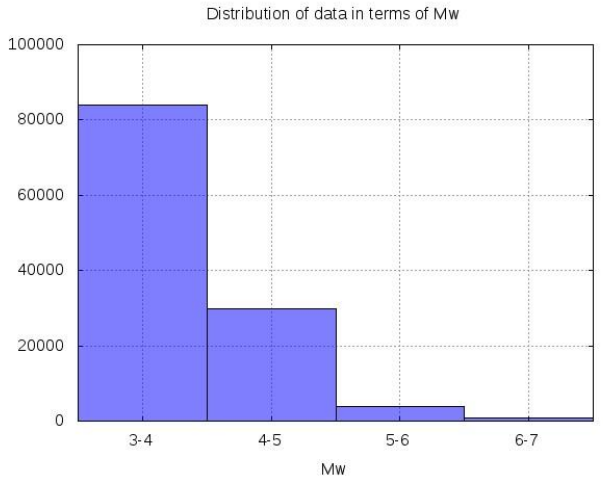
Dataset

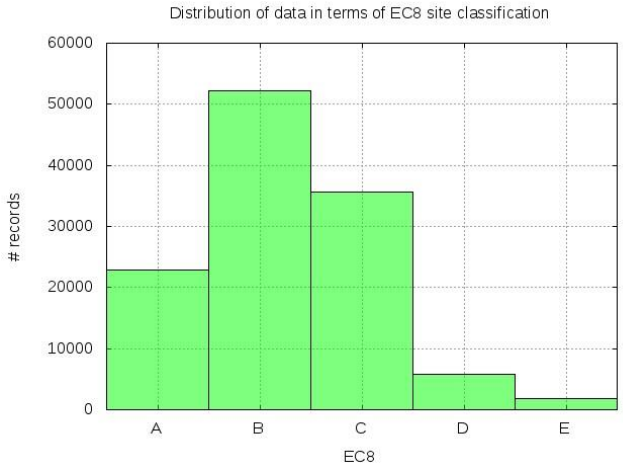
Time-span : 2011-2017



The entire database counts 1985 earthquakes with a moment magnitude between 3.0 and 6.4 of the strongest event of Amatrice sequence occurred the 30th of October, 2016.

The total number of records are 118021 up to 150 km.

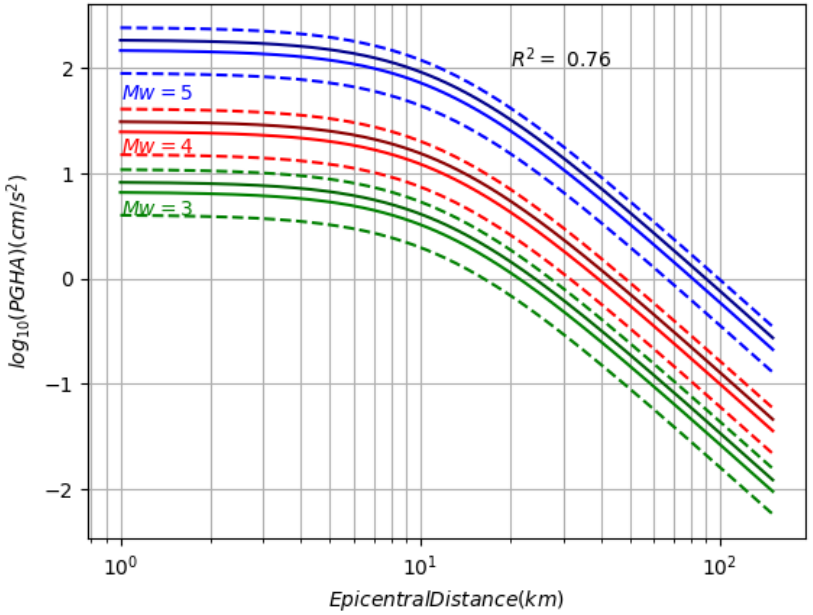


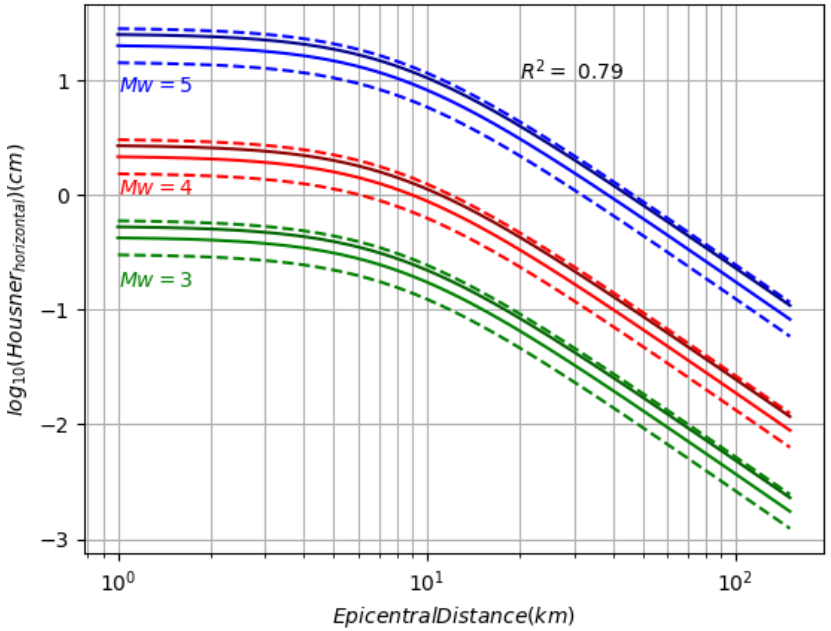


(Tiberi et al. 2018)

GMPE functional form:

$$Log_{10}Y = a + b\,Mw + c\,Mw^{\wedge}2 + c\log_{10}((R^2 + d^2)^{1/2}) + s1SA + s2SB + s3SC + s4SD + s5SE$$



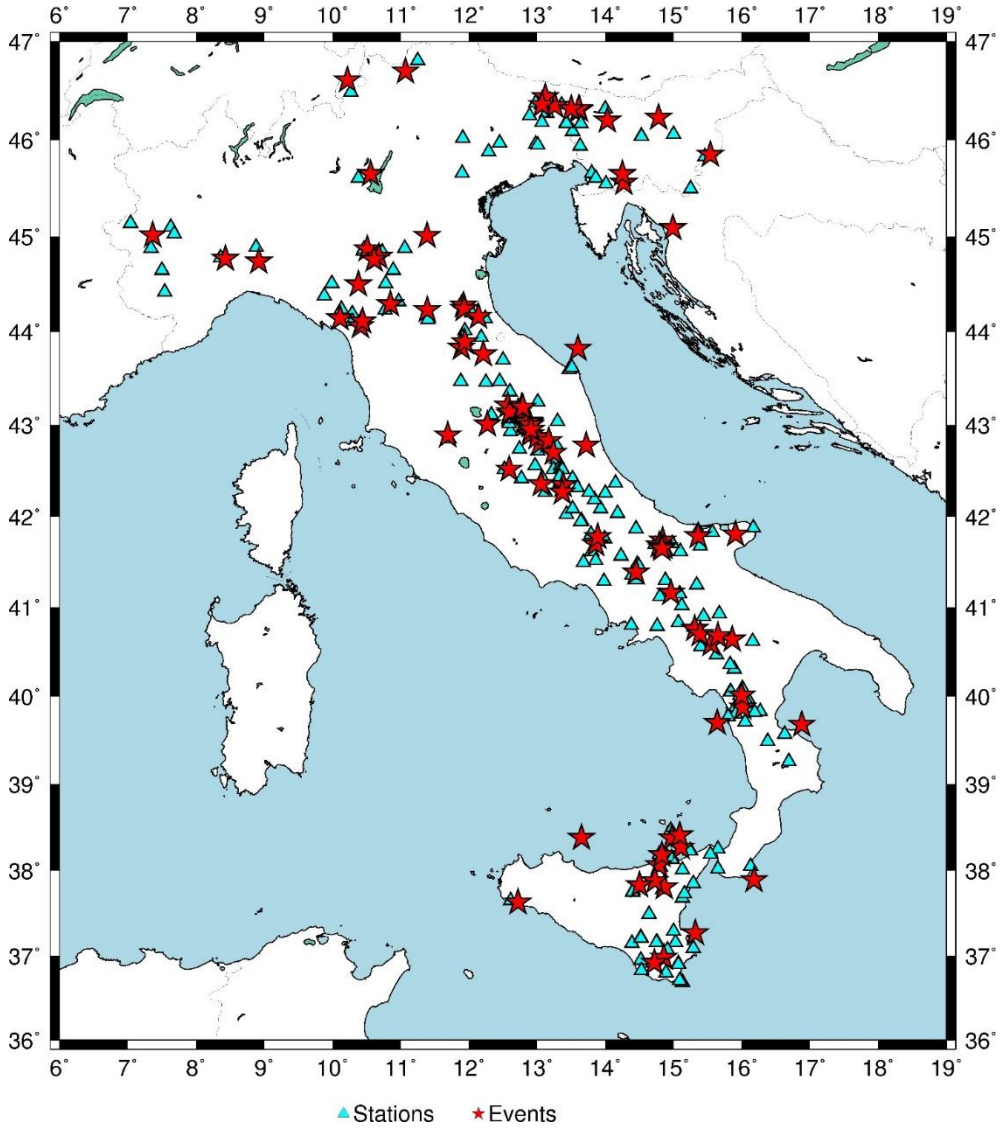


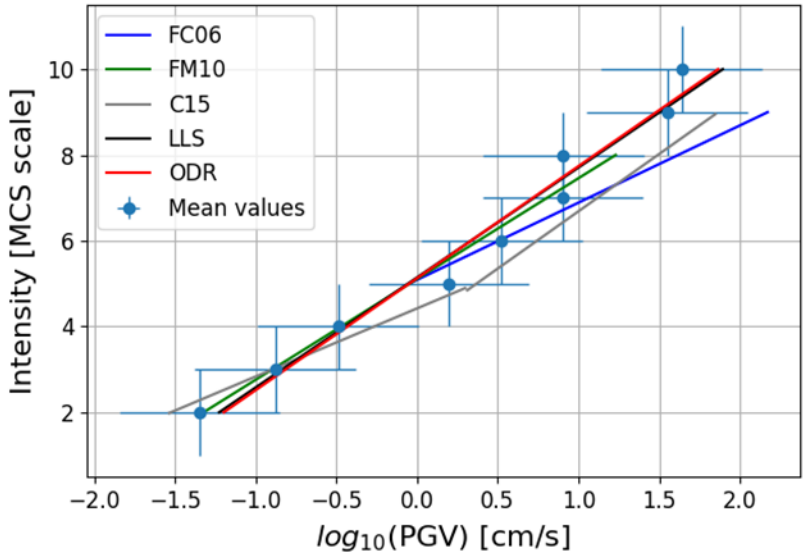
Ground motion parameters analyzed:

PGA
PGV
PGD
PSA03
PSA10
PSA30
Arias Intensity
Housner Intensity

(Tiberi et al. 2018)

A new estimation of MCS instrumental intensity for the Italian territory from high quality accelerometric data, using GMICEs and Gaussian Naïve Bayes Classifiers





Comparison of the Intensity - PGV relationship obtained in this study with the two different algorithms (LLS, ODR) and three previous studies: Faenza and Michelini (2010), FM10; Faccioli and Cauzzi (2006), FC06; Caprio et al. (2015), C15. **(Bottom)** Comparison of the Intensity - PGA relationship obtained in this study with the two different algorithms (LLS, ODR) and the same previous three studies.

(Cataldi et al. 2019)

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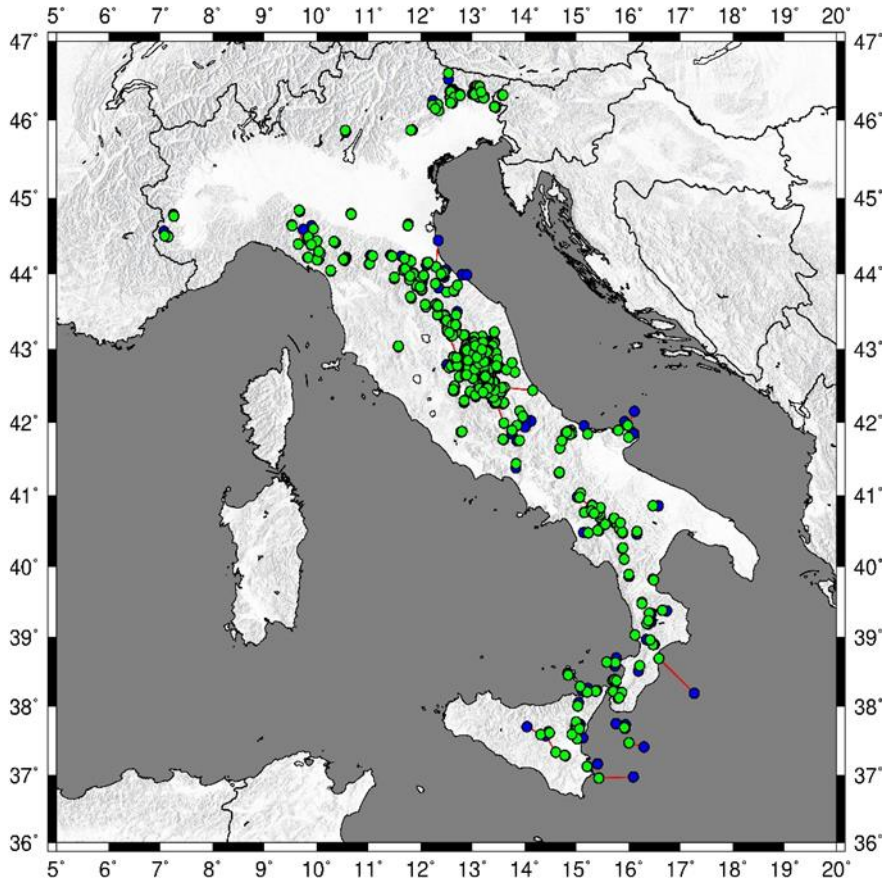

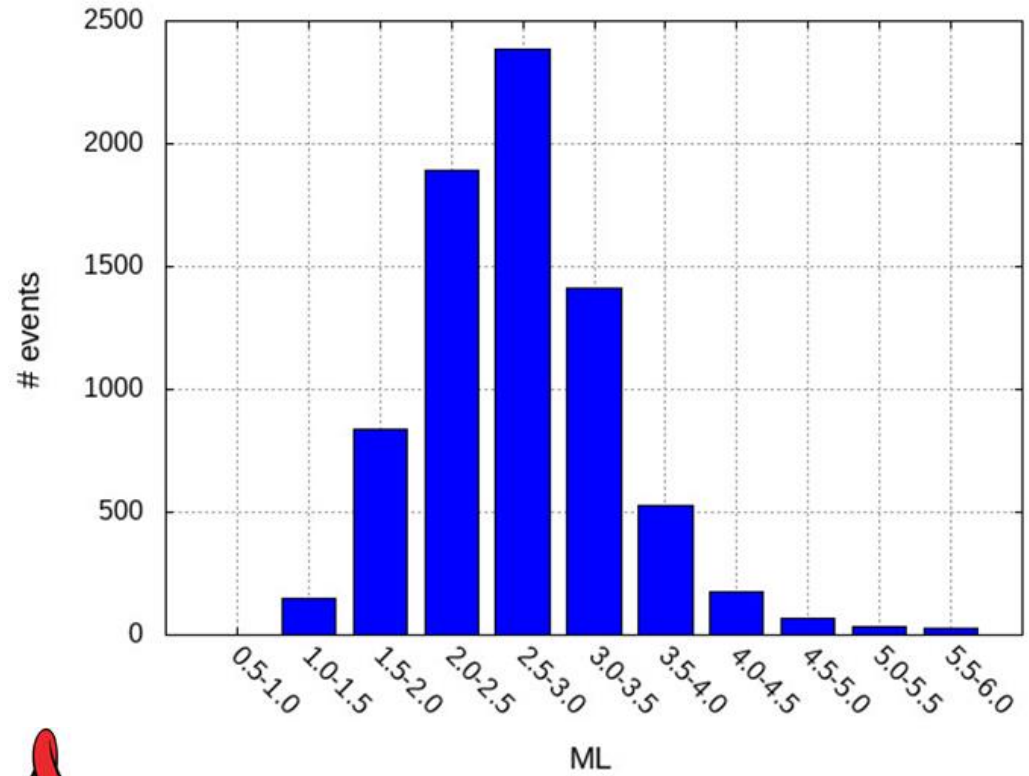

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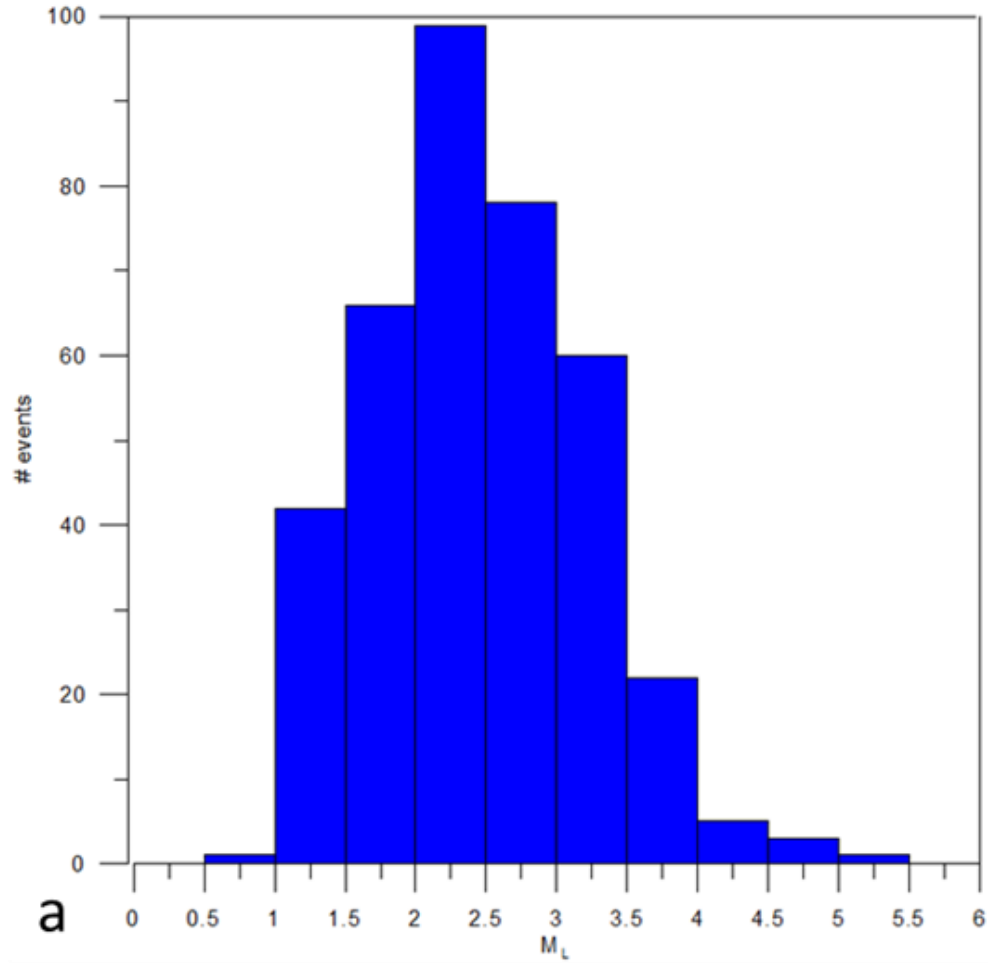

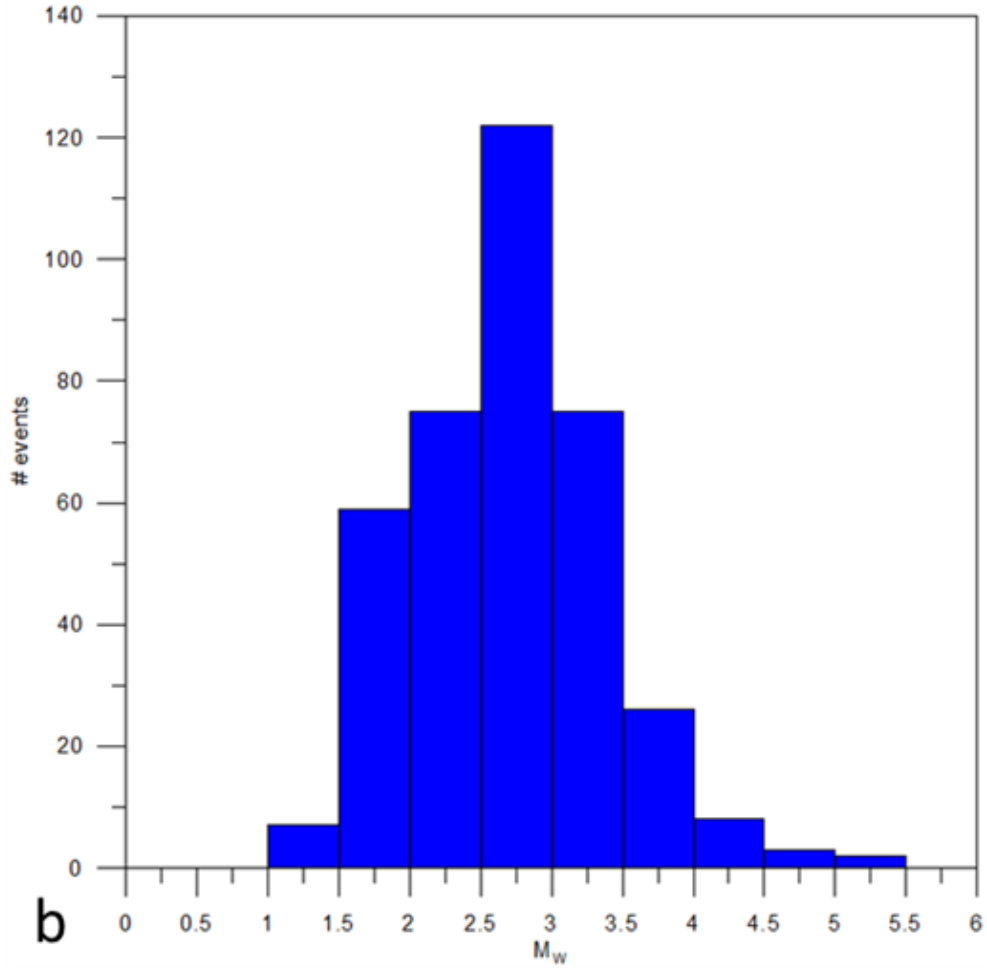

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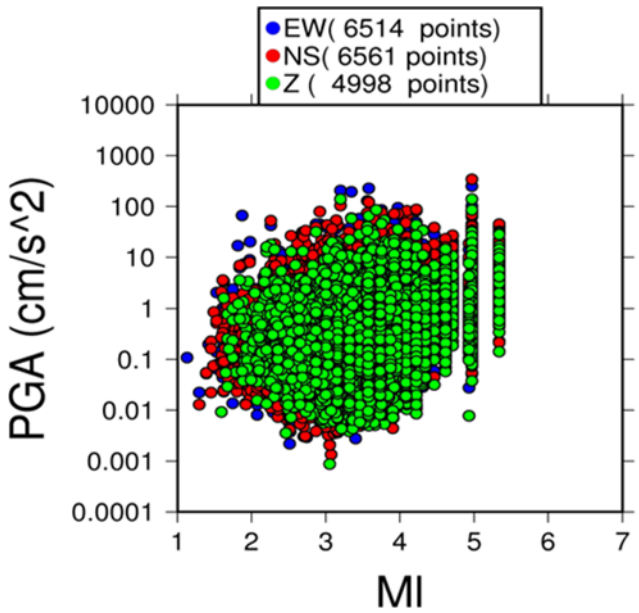

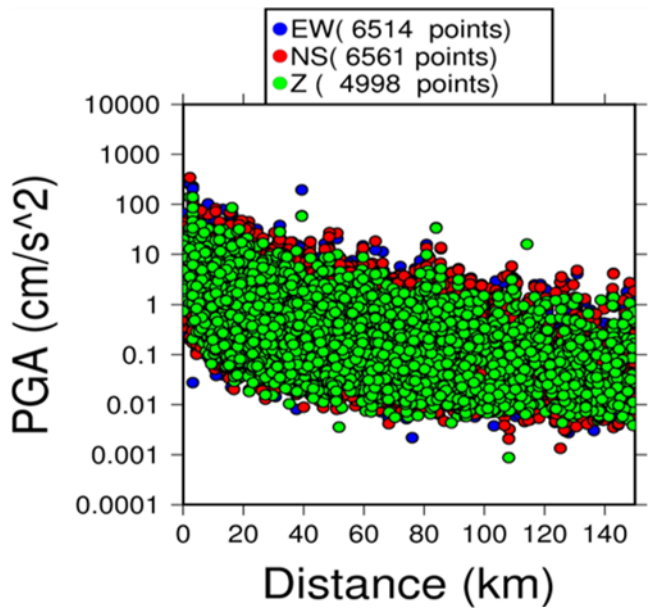

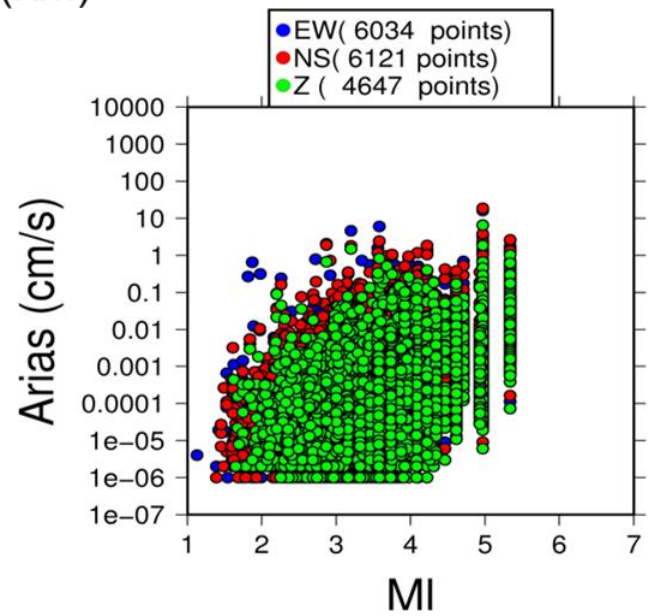

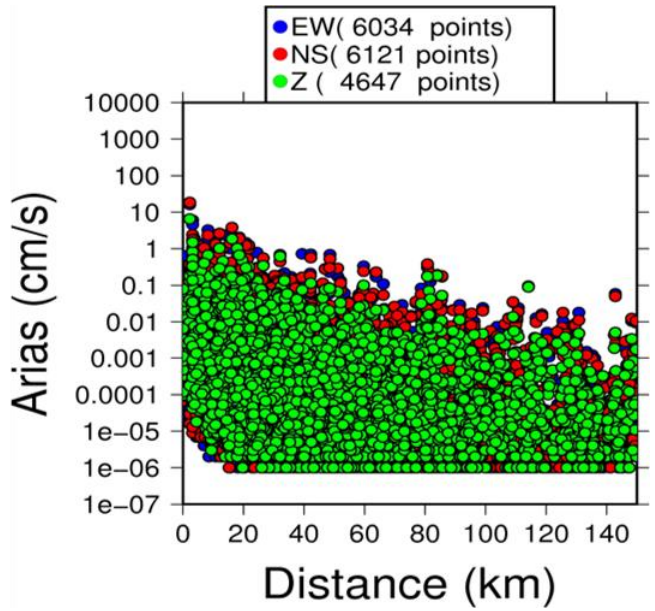

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