International Training Course
ISOLA

DATA FROM COSTA RICA
OVSICORI-UNA

JUAN SEGURA

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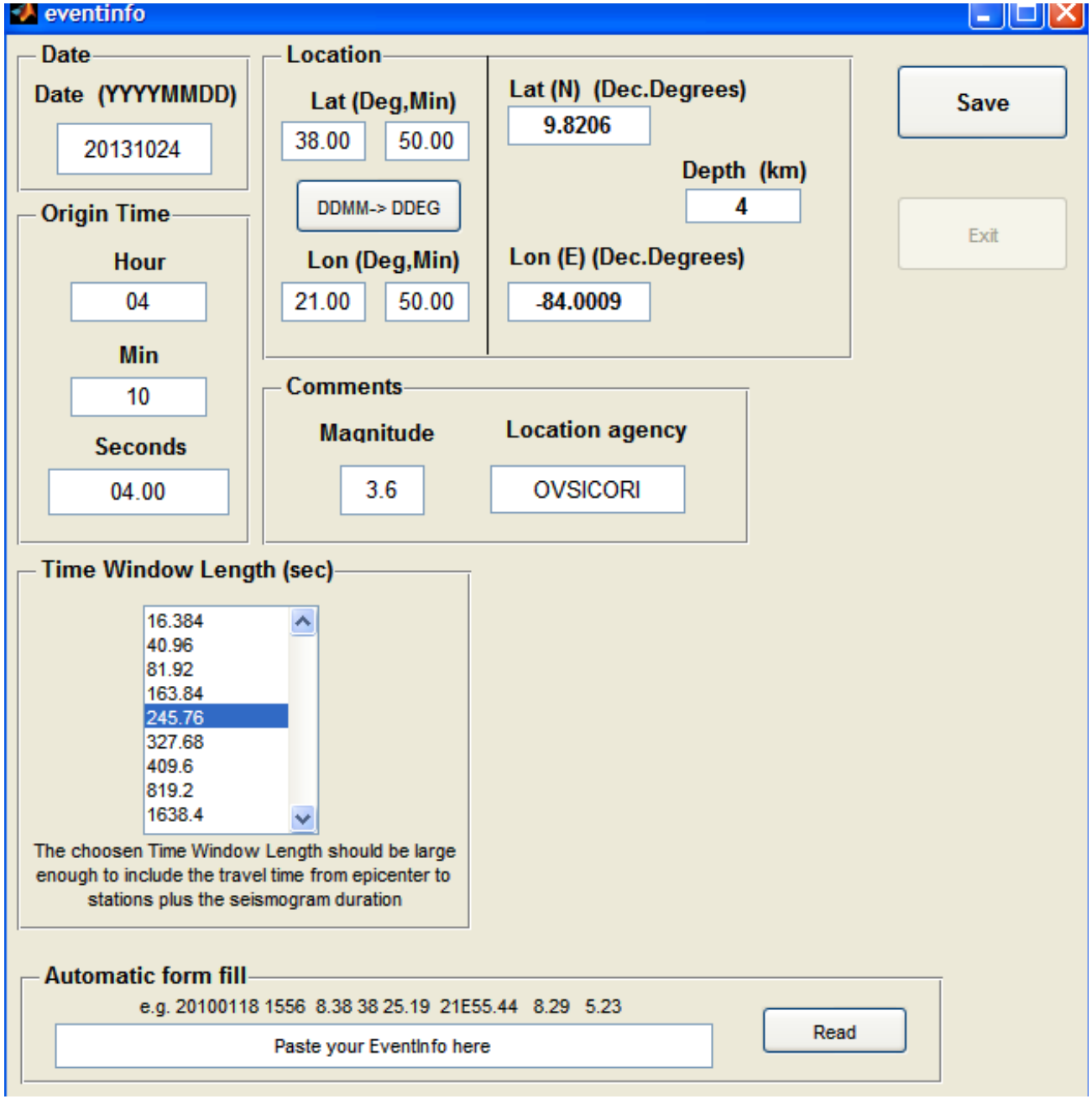
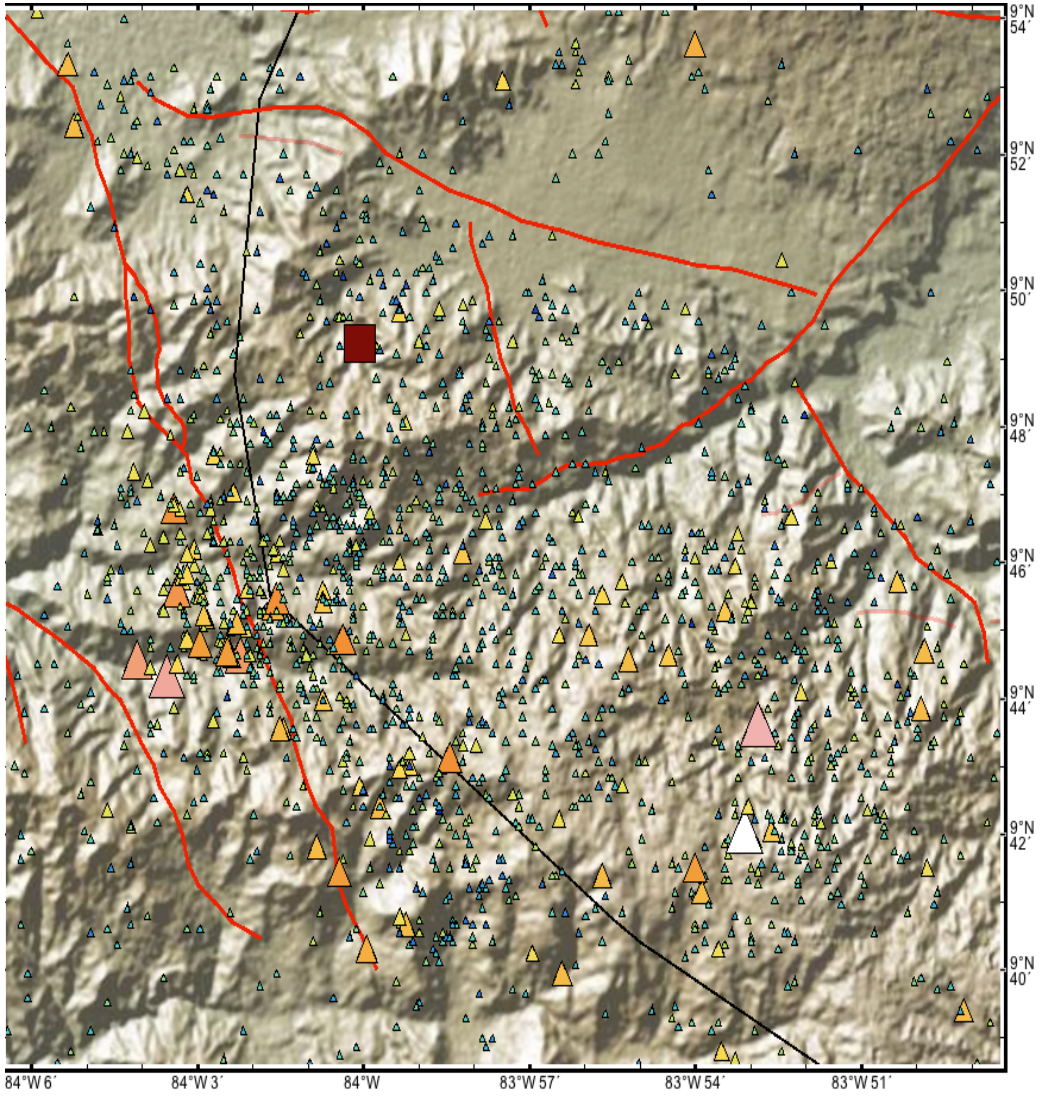
December 2013

Event info Windows



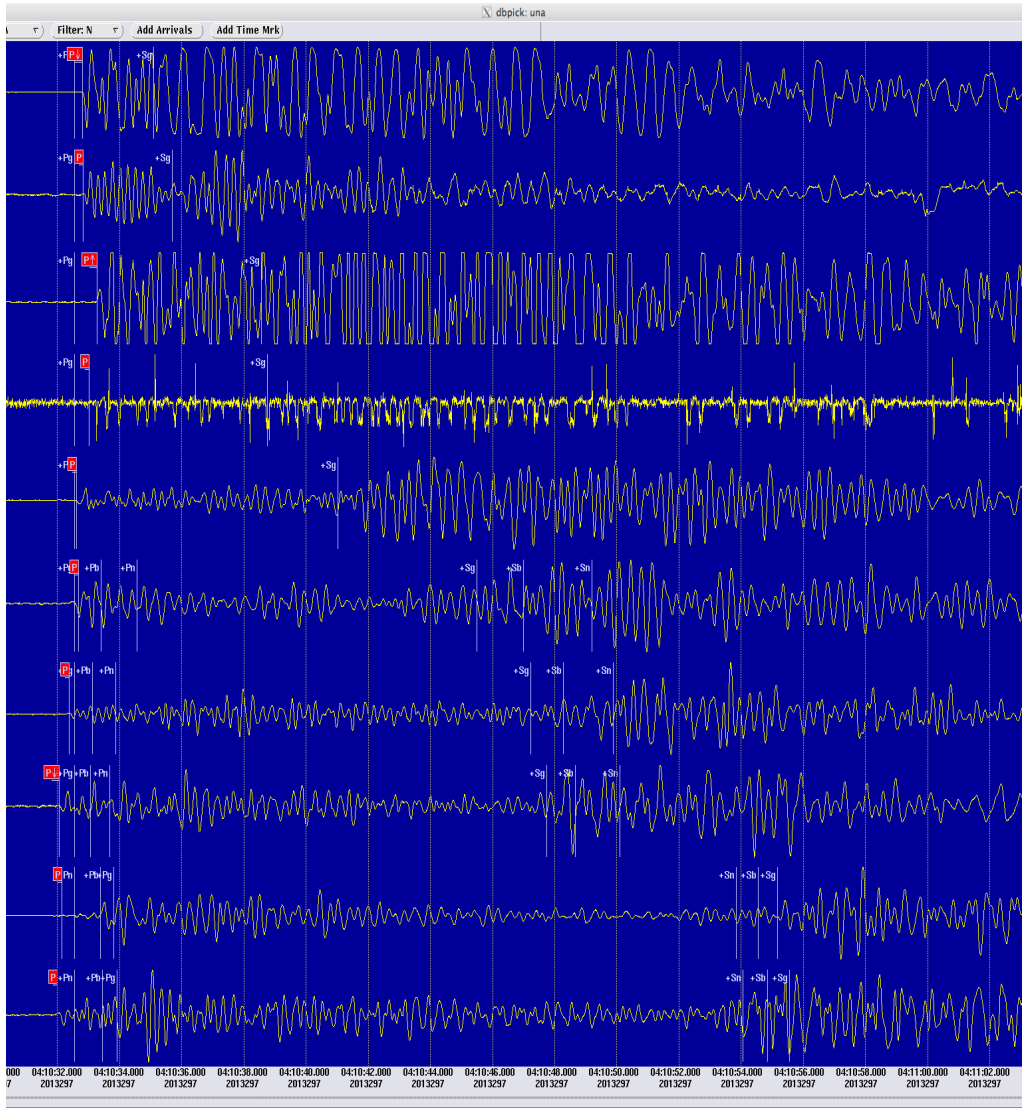
The event origin time is 20131024 0410 32.55, since the nearby station TJAR has P arrival 2 second later from the origin time, we modified the origin time to be 28 second early and will find the centroid around 28 second later from the imposed origin time.

Central Valley CR



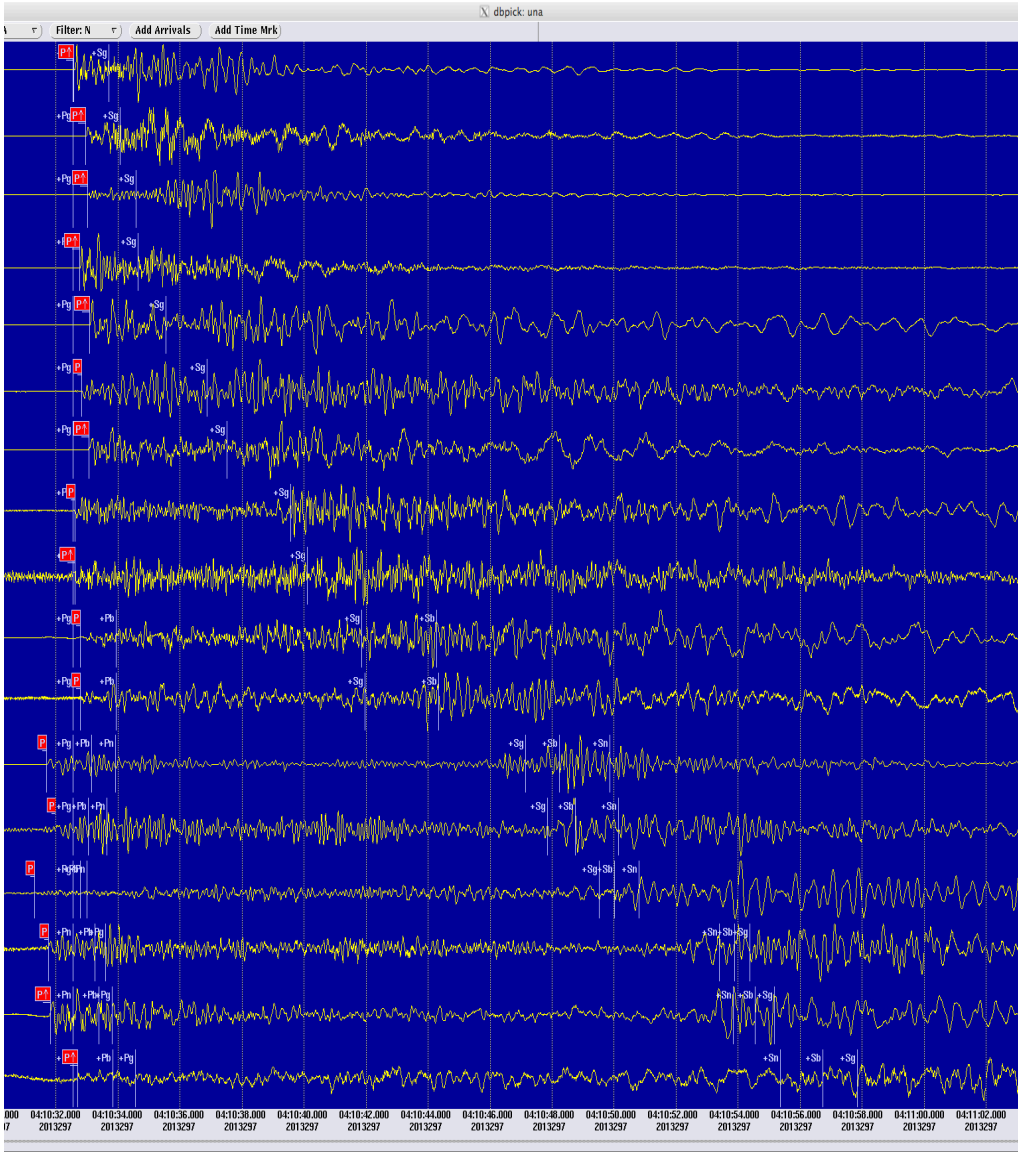
Earthquakes recorded by OVSICORI-UNA in the Central Valley of Costa Rica from 1984 to 2013. The earthquake in study is shown by a square, color brown. This zone is important since in 1910 a moderate earthquake reached intensity VIII in the epicentral area.

Short Period stations



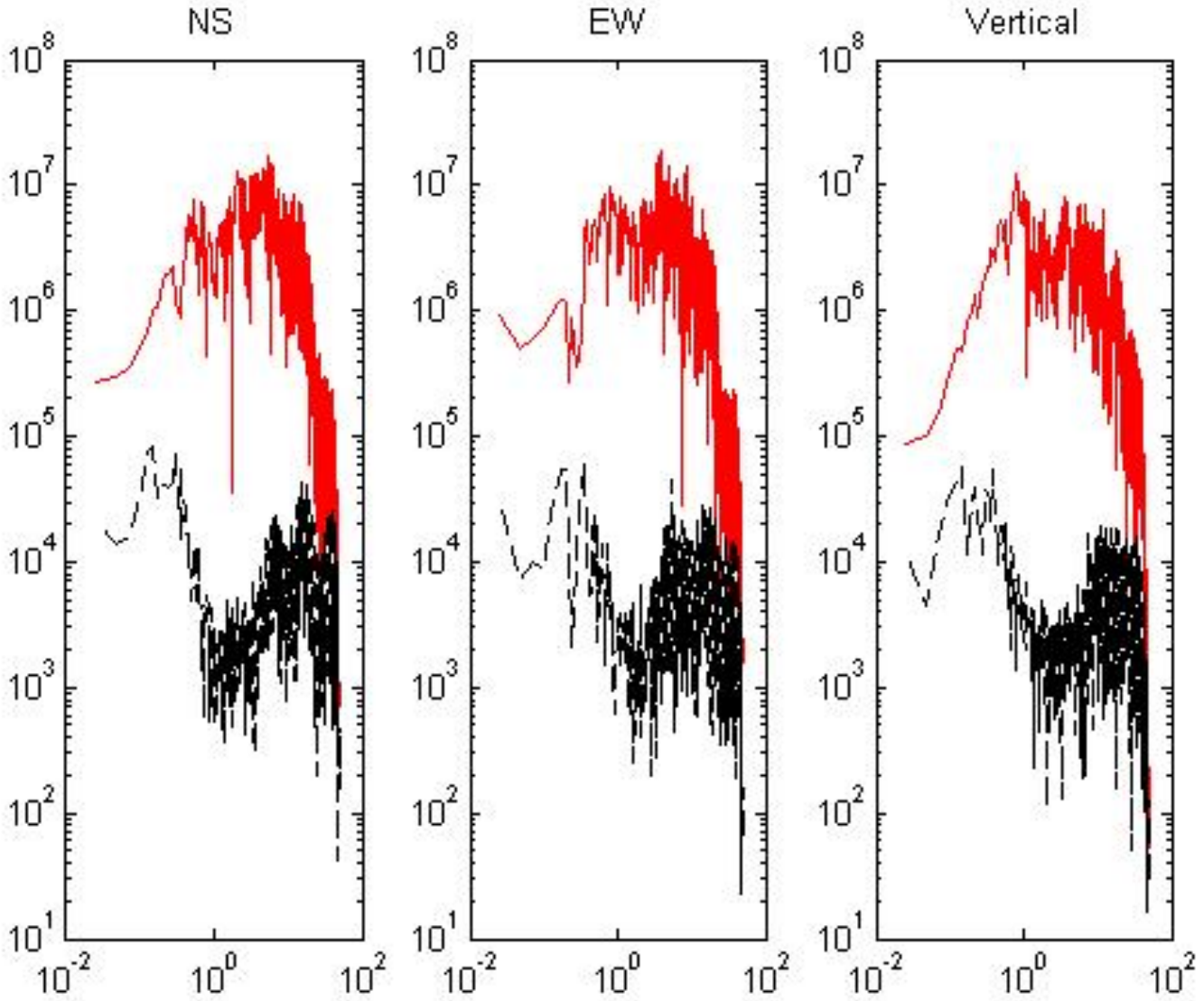
- These short period stations recorded the seismic event; and used in the earthquake location
- Short period stations are instrumented with Ranger 1-sec.

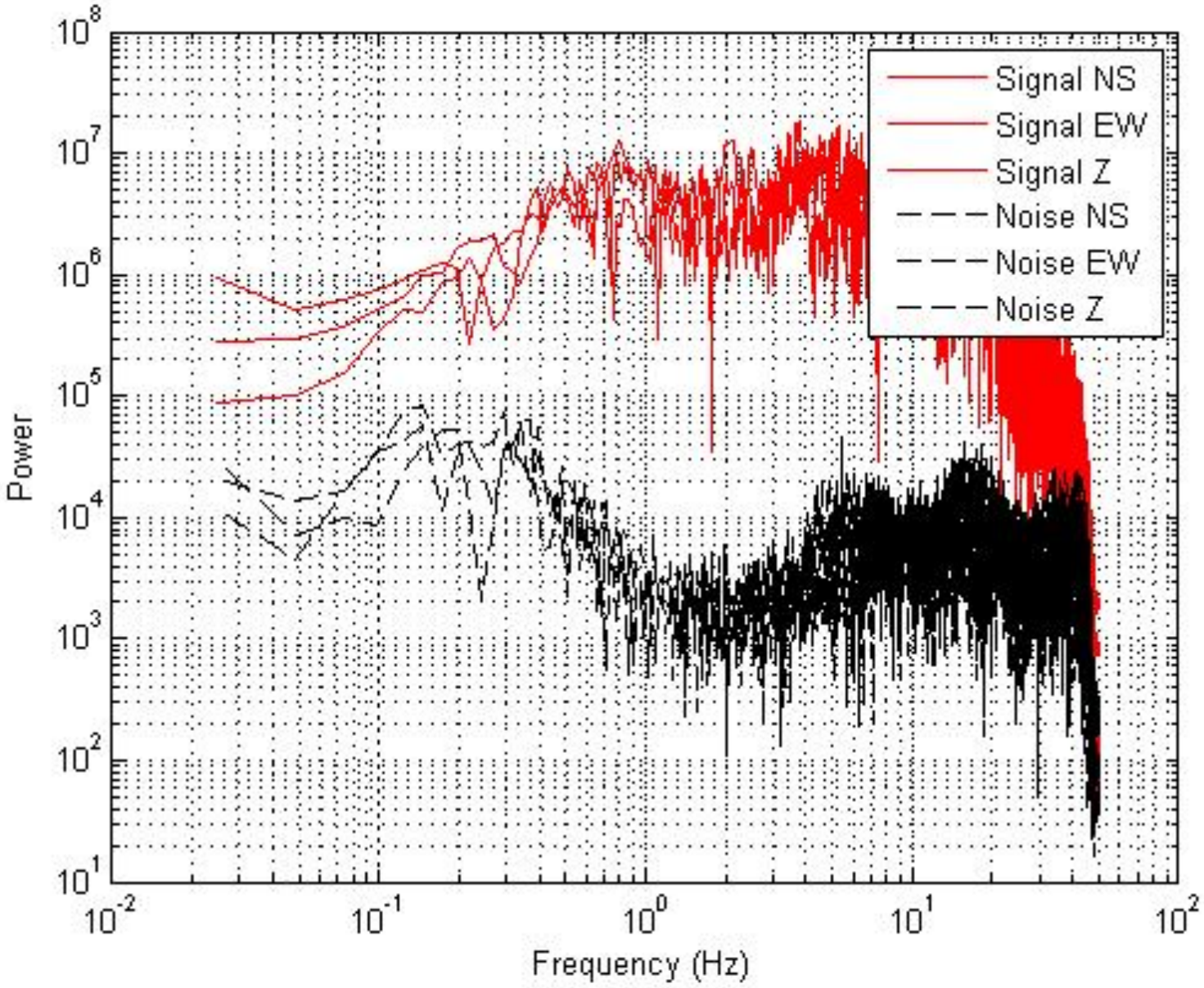
Broad band Stations



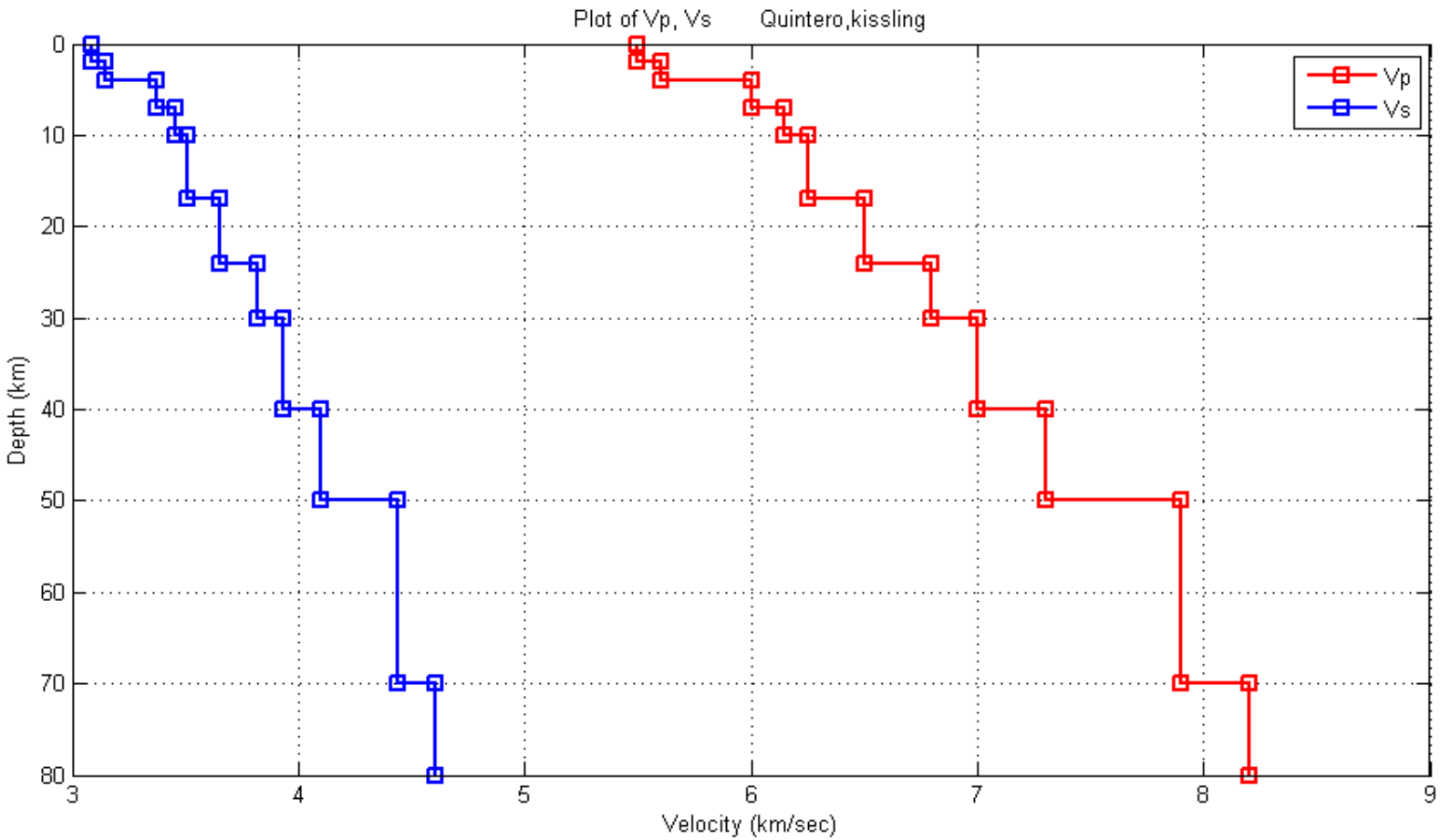
Broad band stations that recorded the earthquake Ml 4.2 on 2013/10/24 041032.55, depth 4.0 km. The stations are trillium compact and Taurus digitizer or STS2 or Trillium 240 with Q330. To make a selection of stations for MT, we analyzed SNR ratio and displacement spectrum using SEISGRAM program

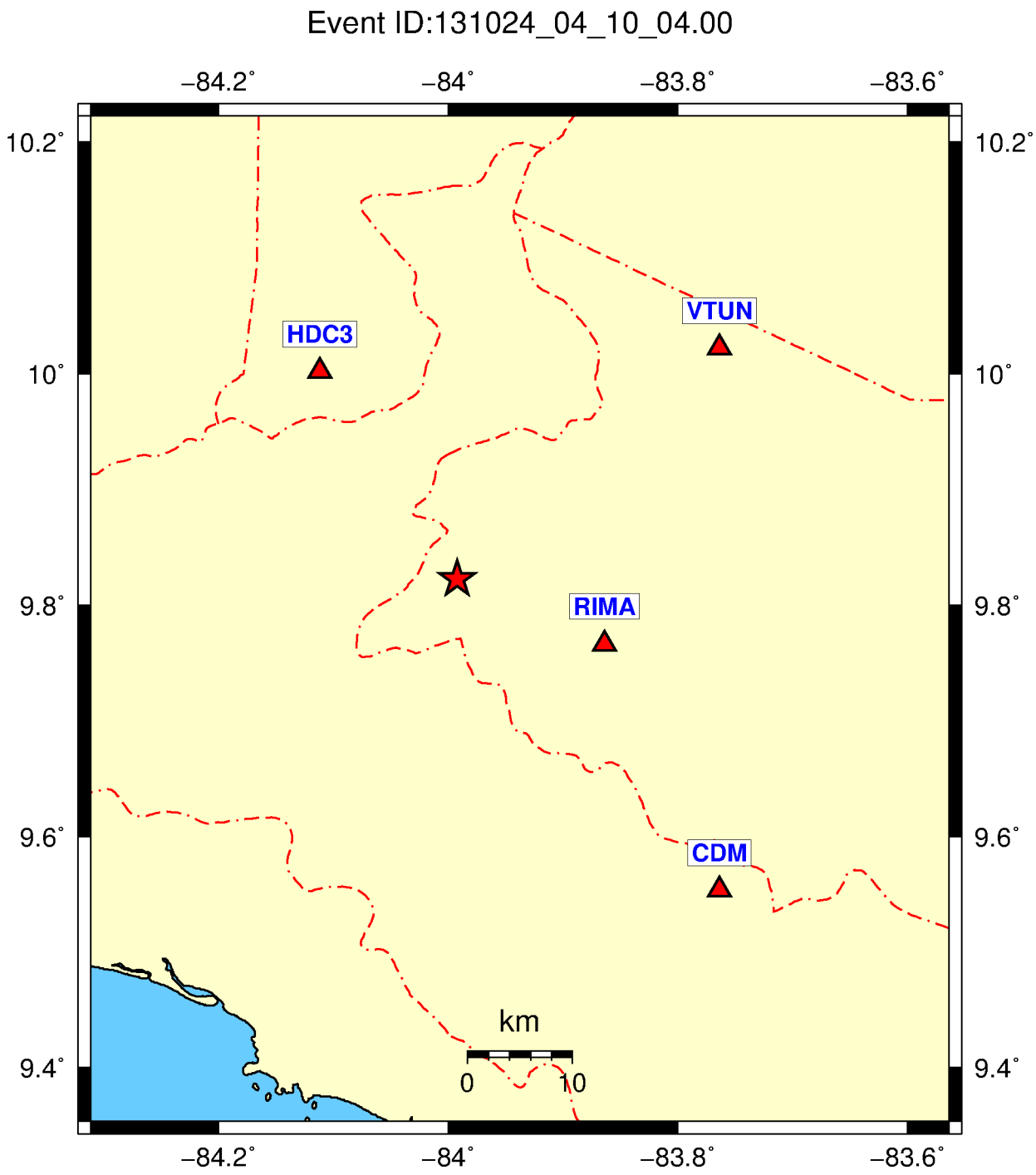
Example of Signal to Noise Ratio used for selecting stations and their band in the Moment Tensor Inversion

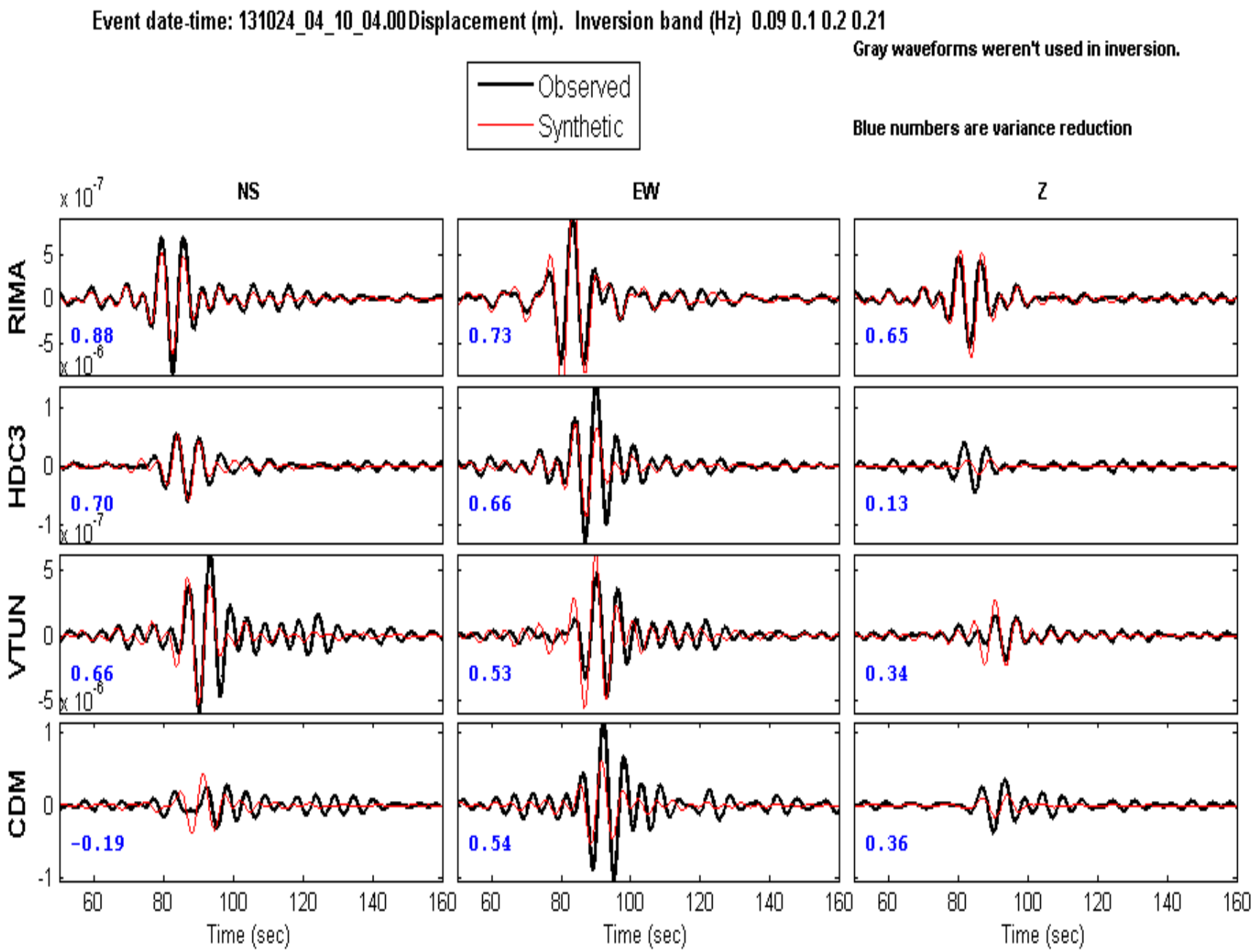


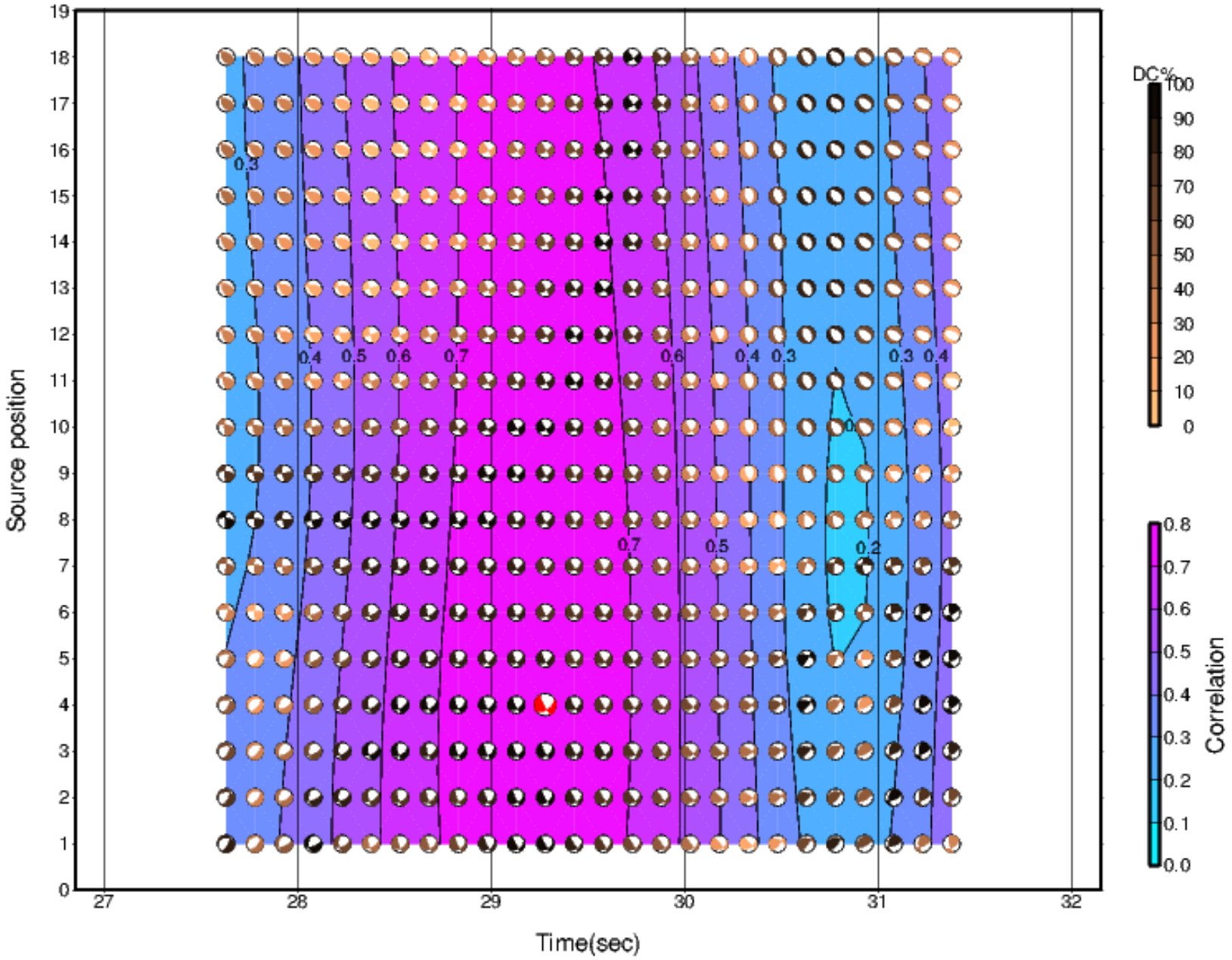

Signal NS
Signal EW
Signal Z
Noise NS
Noise EW
Noise Z
Power
Frequency (Hz)
10^{8}
10^{7}
10^{6}
10^{5}
10^{4}
10^{3}
10^{2}
10^{1}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}

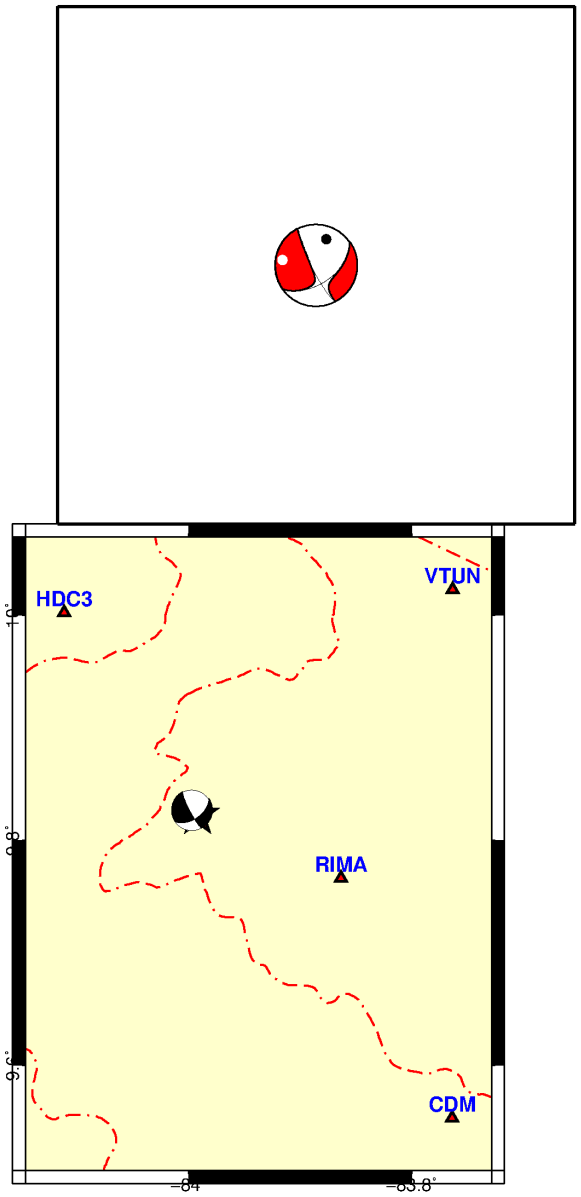
Velocity Model used in the inversion




Event ID:131024_04_10_04.00
−84.2˚
−84˚
−83.8˚
−83.6˚
10.2˚
10˚
9.8˚
9.6˚
9.4˚
HDC3
VTUN
RIMA
CDM
km
0
10


Event date-time: 131024_04_10_04.00 Displacement (m). Inversion band (Hz) 0.09 0.1 0.2 0.21
Gray waveforms weren't used in inversion.
Observed
Synthetic
Blue numbers are variance reduction
NS
EW
Z
RIMA
HDC3
VTUN
CDM
0.88
0.73
0.65
0.70
0.66
0.13
0.66
0.53
0.34
-0.19
0.54
0.36
Time (sec)


Source position
Time(sec)
DC%
Correlation
0.3
0.4
0.5
0.6
0.7
0.6
0.4
0.3
0.3
0.4
0.7
0.5
0.2



MOMENT TENSOR SOLUTION

HYPOCENTER LOCATION (OVSICORI)

Origin time 20131024 04:10:04.00
Lat 9.827 Lon -83.997 Depth 4.2

CENTROID

Trial source number : 4 (Fixed Epicenter inversion)
Centroid Lat (N)9.827 Lon (E)-83.997
Centroid Depth (km) : 1.2
Centroid time : +29.28 (sec) relative to origin time

Moment (Nm) : 7.279e+13
Mw : 3.2
VOL% :0
DC% :87.5
CLVD% :12.5

		SNR	CN	FMVAR	STVAR
Var.red.:	(for stations used in inversion):0.61	NaN	3.7	16±7	0.21
Var.red.	(for all stations) :0.61				

Strike	Dip	Rake
55	53	-12
Strike	Dip	Rake
153	81	-142

P-axis	Azimuth	Plunge
	21	33
T-axis	Azimuth	Plunge
	279	18

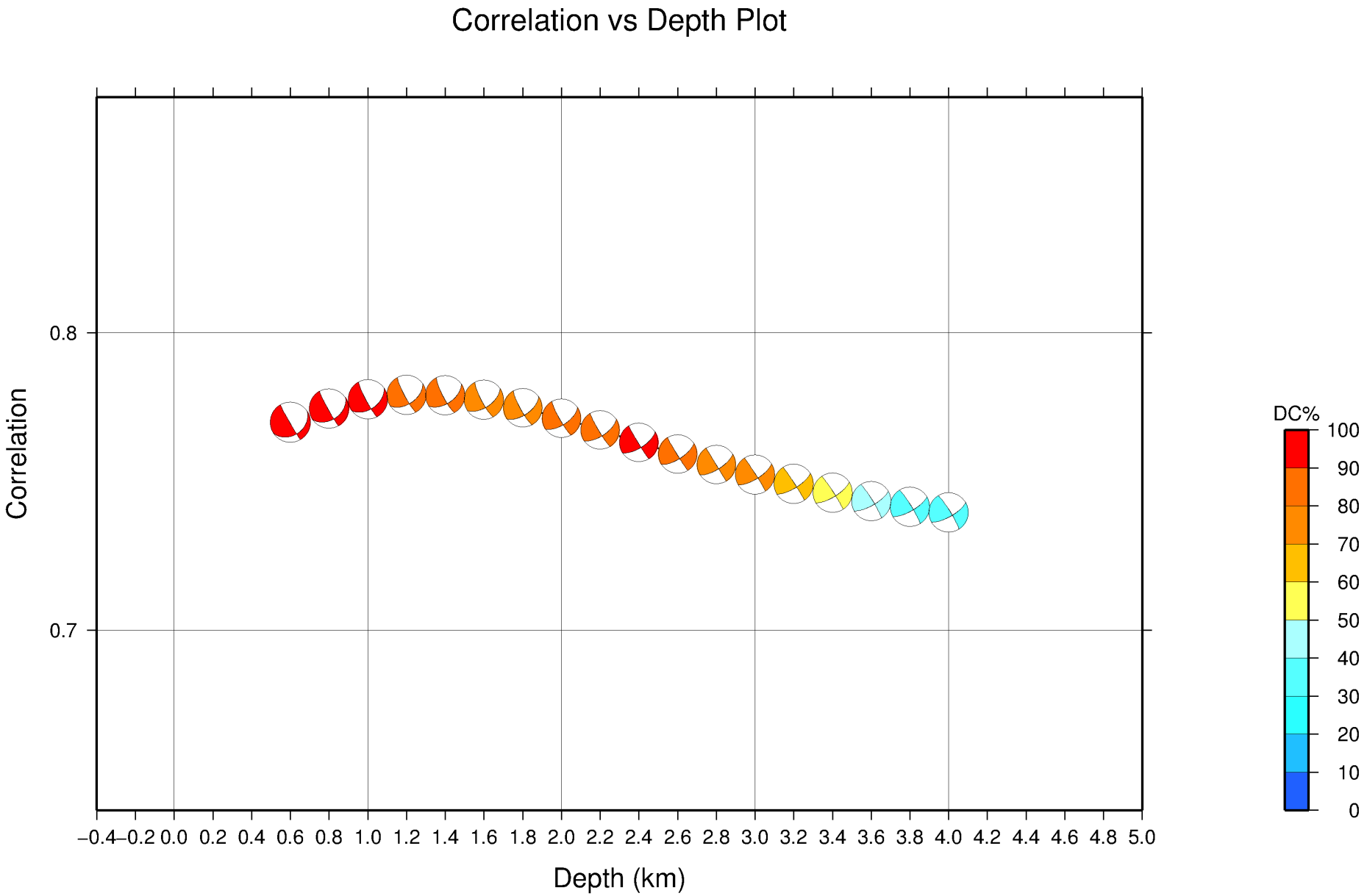
Mrr	Mtt	Mpp
-1.633	-4.341	5.974
Mrt	Mrp	Mtp
-2.449	3.412	2.596

Exponent (Nm): 13

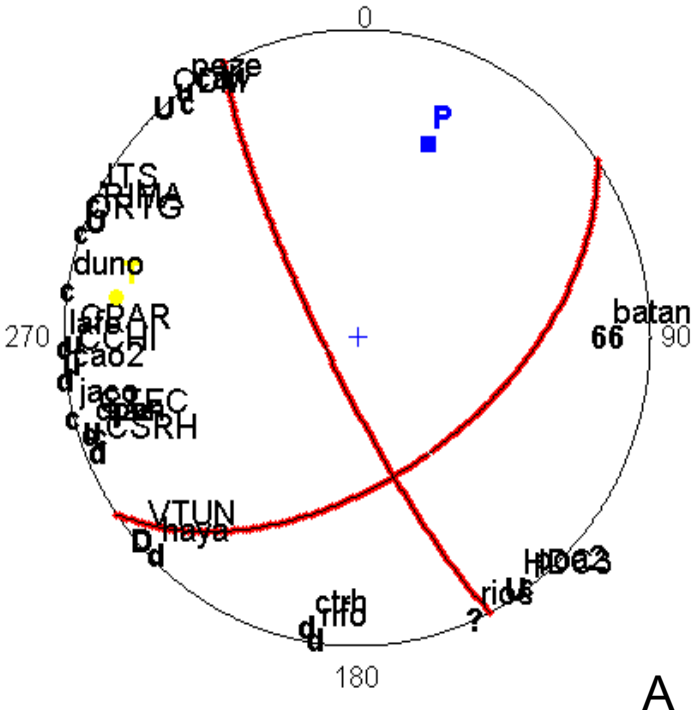
Frequency band used in inversion (Hz)
0.09 - 0.1 -- 0.2 - 0.21

Stations-Components Used-Distance

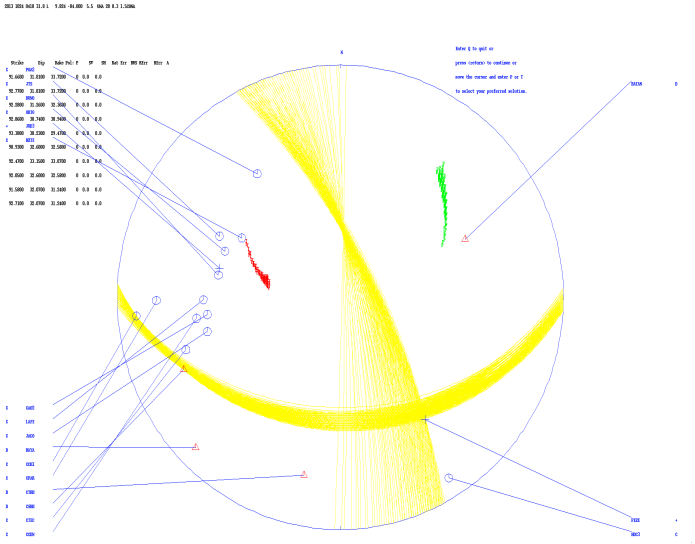
	NS	EW	Z	D(km)
RIMA	+	+	+	15
HDC3	+	+	+	24
VTUN	+	+	+	33
CDM	+	+	+	39


Correlation vs Depth Plot
Correlation
0.8
0.7
–0.4 –0.2 0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4 2.6 2.8 3.0 3.2 3.4 3.6 3.8 4.0 4.2 4.4 4.6 4.8 5.0
Depth (km)
DC%
100
90
80
70
60
50
40
30
20
10
0

FIRST MOTION POLARITY



A



B

Using window plot result from ISOLA and the tool polarity, we included other stations not used in the inversion to check the mechanism obtained in the inversion. The result is consistent with the obtained waveform mechanism and is shown in the figure A.

In the Figure B is shown the mechanism obtained using FOCMEC program which is incorporated into SEISAN. For the focal mechanism different depth were used. In general both result are consistent shown a strike slip mechanism.

CONCLUSION

We select a weak seismic event from central Costa Rica for the Moment Tensor (MT). Although several stations very close to the epicenter recorded the event, we had low resolution when stations TJAR, CALV and CPAN composed of TRILLIUM COMPACT (TC) + TAURUS digitizer and data from the low gain seismometer SMA-130 were used in the inversion. At the end only stations (RIMA, HDC3, VTUN, CDM) with STS2 + Q330 were used to calculated the MT, distance between 15.4 and 38.9 km and frequency 0.1 to 0.2 Hz. For the final result different velocity models were tested and at the end the Quintero & Kissling (2001) velocity model were used. Focal Mechanism obtained using ISOLA are consistent with mechanism obtained using FOCMEC. We recommend to check the orientation of the temporary stations composed of TC + TAURUS, for being using in future inversion of weak events, with these improvements we could have more chance to obtain moment tensor for those events in the central Costa Rica, a zone with high seismic risk.