PRELIMINARY REPORT

The earthquake of January 8, 2013 at SE of Limnos Island, Northern Aegean, Greece

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At 16:16 local time (14:16 GMT) January 8, 2013 a moderate size earthquake ML5.8 (Mw5.7) occurred 40 km SE off the coasts of Limnos island, Northern Aegean, Greece. The epicenter coordinates were calculated to 39.636N 25.576E and the focal depth to 32.3 km (MT centroid depth 8 km) according to the Institute of Geodynamics, National Observatory of Athens (NOAIG). The earthquake was felt at a wide area (the radius over 250km), especially by the population of the surrounding islands in the NE Greece and NW Turkey, as well as by people in Athens (250 km away).

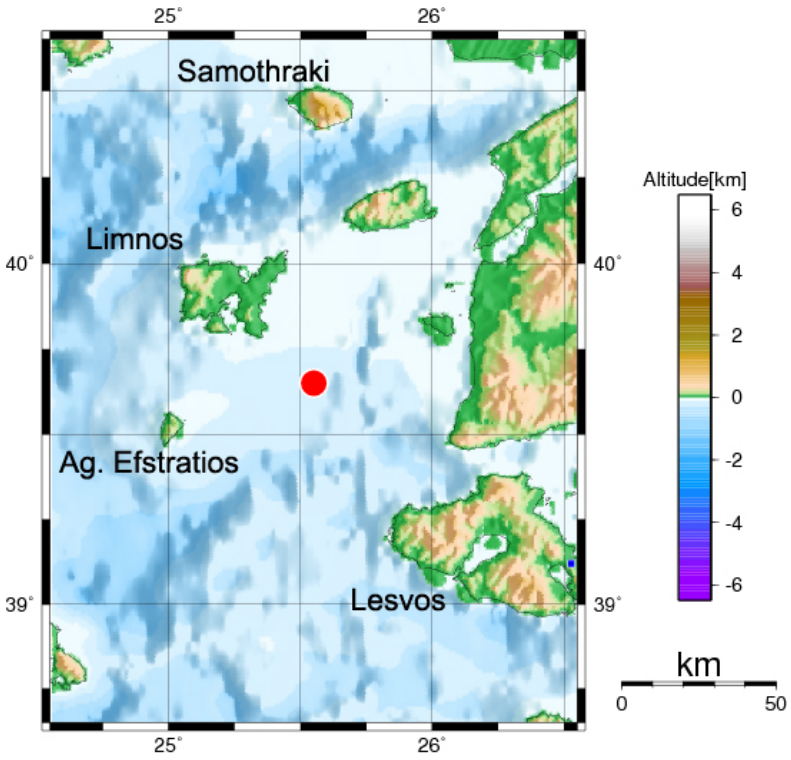

Figure 1. Map of the epicentral area. Red circle notes the epicenter (ref. http://bbnet.gein.noa.gr).

NOAIG strong motion network (http://accelnet.gein.noa.gr) recorded the event. Strong motion stations have a good azimuthal coverage around the epicenter and their data were used for both the automatic and manual location procedures at NOAIG, as well as for Moment Tensor inversion and the estimation of strong ground motion peak values. Figure 2 shows the focal mechanism solution corresponding to a strike-slip seismogenic fault. For this high quality solution nine strong motion recordings were used (LIA, EFSA, PRK, SMTH, PSRA, ALXA, ALNA, THSA, KVLA) and three broadband (SKY, ALN, ATH).

The NOAIG strong motion network contains instruments operating in triggering mode (11-12 bit resolution), none of which were triggered by the present earthquake and modern instruments operating in continuous mode (24bit resolution). All instruments are monitored remotely using the Greek Public Sector network “Syzefxis”, thus the continuously recording instruments transmit the data in real time, which were processed immediately after the

earthquake occurrence. The 24-bit resolution instruments allow the recording of moderate or strong earthquakes at even long distances, resulting in such a way to an enrichment of the local and regional attenuation relationships.

The preliminary record processing, which is presented here, included the strong motion records from instruments in the area (epicentral distances 45-200 km), plus the records from two of the strong motion stations operating in Athens and Thessaloniki (epicentral distances of about 250 km), and two records from longer distances (of about 500 km) being located at the NW and the SE on land geographical end points in Greece.

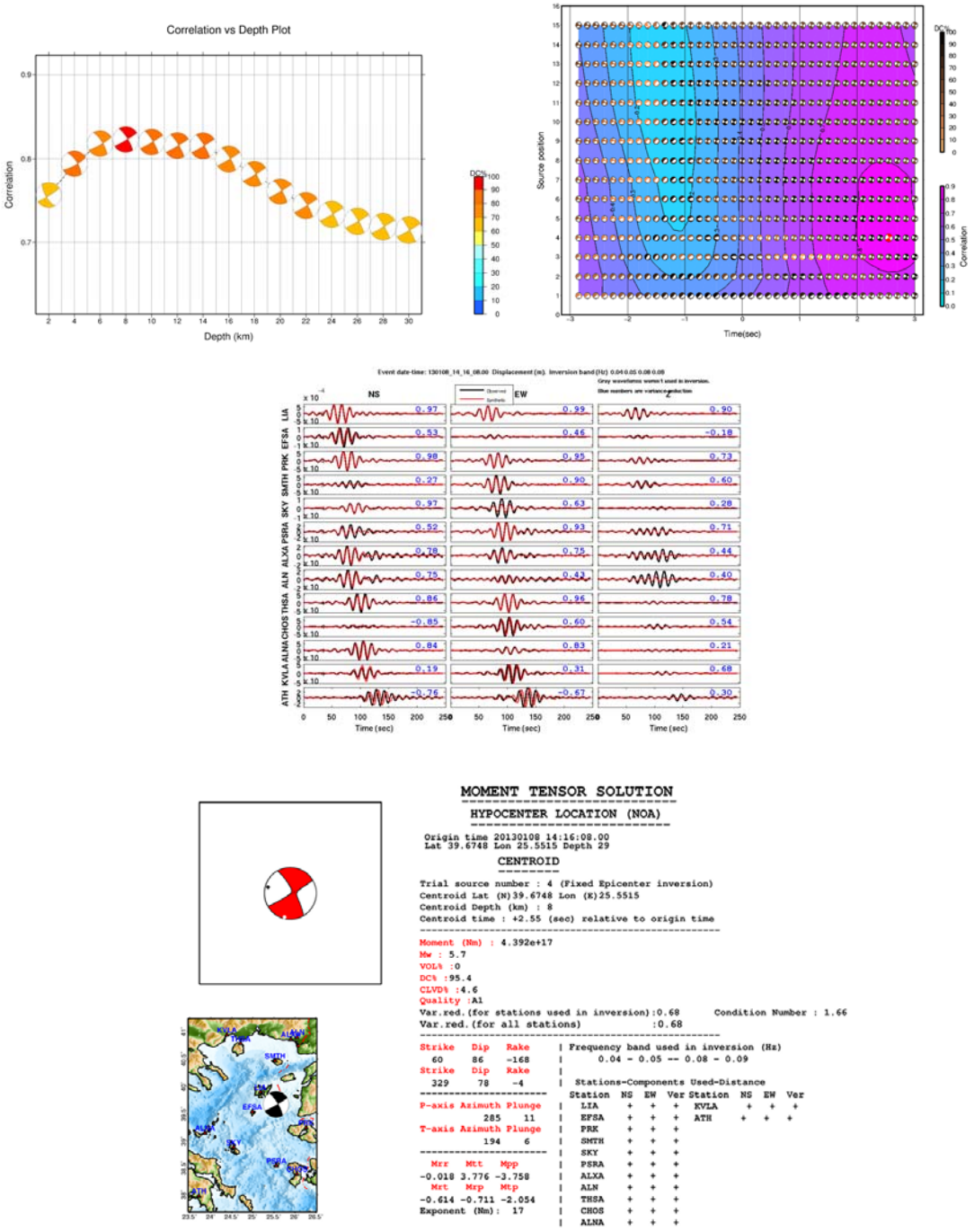

Figure 2. The focal mechanism solution showing a strike-slip fault (ref. http://bbnet.gein.noa.gr/mt_solution/2013/130108_14_16_08.00_MTsol.html).

The calculated peak ground acceleration values (PGA) were not exceeded the 27 cm/s2 at the island of Agios Efstratios (EFSA) and the 20 cm/s2 at the island of Limnos (LIA) with epicentral distances of 50 and 45 km and with local conditions of soil and rock respectively. Table 1 includes the calculated PGA values from indicative instruments of the NOAIG strong motion network.

Table 1. Information about the strong motion stations and the PGA values calculated from the preliminary processing of the strong motion records. The exact location of the instruments can be found at
http://accelnet.gein.noa.gr/index.php?option=com_wrapper&view=wrapper&Itemid=209

Station Code	Location / Building	Soil Conditions	Distance (km)	PGA (cm/s^2)		
				Z	X	Y
LIA	Limnos / Seismic Station	Rock	45	11.7	20,4	14.6
EFSA	Aghios Efstratios / Town Hall	Alluvium	50	15.0	19.0	27.1
SMTH	Samothraki / Seismic Station	Rock	80	5.5	6.4	5.4
PSRA	Psara / Town Hall	Alluvium	130	3.6	6.8	10.9
ALXA	Alexandroupolis / Nat. Hist. Museum	Alluvium	130	4.4	7.2	7.4
THSA	Thassos / Forest Service	Alluvium	140	4.0	8.4	8.4
XANC	Avdira / Town Hall	Alluvium	155	1.3	2.2	2.4
ALNA	Alonissos / Town Hall	Alluvium	155	2.0	2.7	2.6
KOMA	Komotini / Region	Alluvium	160	2.6	5.0	6.8
KVLA	Kavala / Forest Service	Rock	170	1.4	2.5	2.2
PLG	Polygyros / Seismic Station	Rock	200	0.8	0.4	0.5
TRGA	Trigono / Town Hall	Alluvium	230	1.2	2.2	2.0
NVR	Nevrokopi / Seismic Station	Rock	140	0.3	0.4	0.5
NOAC	Athens / Seismic Sattion	Rock	255	0.4	0.7	0.7
OREA	Oreokastro / Town Hall	Alluvium	260	0.3	0.5	0.4
KASA	Kassiopi / Town Hall	Rock	490	0.02	0.03	0.02
KSL	Kastelorizo / Seismic Station	Rock	530	0.04	0.05	0.10

Figure 3 presents a comparison of the strong motion records shorted according to increasing epicentral distance. From top to bottom the three components of each instrument are presented (Z – green, Y – red, X – blue). The rapid decrease of amplitudes is apparent due to the attenuation of the seismic energy with distance, as well as the significant role of the local conditions to the strong motion recording. For example, ALXA, KOMA and TRGA show a long duration of recording attributed to the soft soils, which dominate at the site of installations. Moreover, the comparison of the recordings of TRGA (epicentral distance of 200 km) and of PLG (epicentral distance 230km) shows not only the difference in recording duration, but the amplitude difference as well (even 5 times higher PGA at TRGA in comparison to PLG).

Figure 4 presents the two records from the most remotely available instruments from the epicenter, namely KASA to the left (490 km) and KSL to the right (530km). Although both instruments are installed on limestone, the propagation path and perhaps the state of the

limestone (more weathered at KSL than at KASA) forms the records and results to the higher PGA values at KSL.

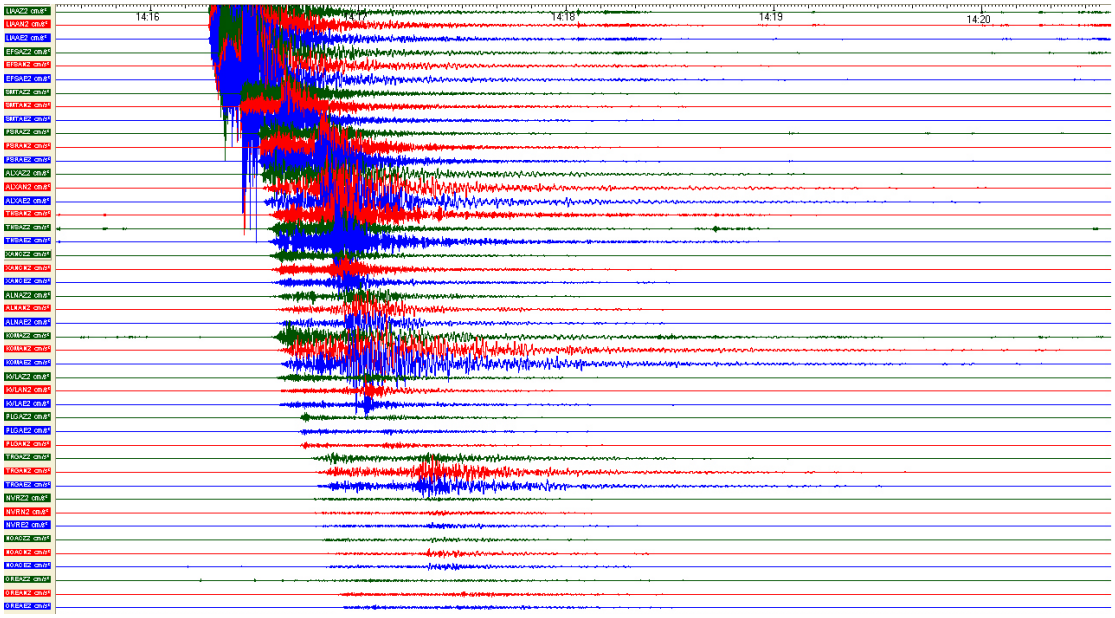

Figure 3. Comparison of the strong motion records at distances between 45 and 250 km. From top to bottom the 3 components of each instrument (Z – green, Y – red, X – blue) of LIA, EFSA, SMTH, PSRA, ALXA, THSA, XANC, ALNA, KOMA, KVLA, PLG, TRGA, NVR, NOAC, OREA.

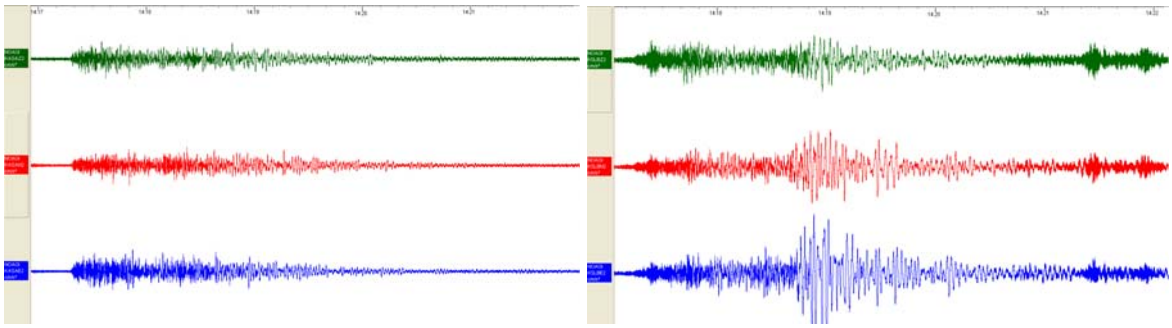

Figure 4. Comparison of the strong motion records of KASA (left) and KSLB (right), as examples of the instrument capability to record reliably at long distances (490 and 530 km respectively).

Finally, Figure 5 presents the calculated PGA values in comparison with the proposed Greek attenuation relationships (ex. Skarlatoudis et al., 2003; Danciu & Tselentis, 2007). The curves refer to surface earthquakes for strike-slip faults and for rock conditions (blue) and for soil conditions (red). The dashed lines represent the standard deviation of the presented relationships. The blue and red symbols denote the rock and soil local conditions for the strong motion sites, respectively. It should be noted that the attenuation relationships were derived from a sample of Greek earthquakes and present the attenuation for epicentral distances up to 200 km epicentral distance, thus reflecting the technical limitations of the old generation instruments (mainly analogue SMA-1 and 11-12 bit resolution instruments).

However, it is showed (Fig 5) that the calculated PGA values are in good agreement with the attenuation relationships for epicentral distances shorter than 200 km. For longer distances (and for real near-field events as well), the modern instruments give the opportunity for new more reliable relationships to be proposed within the frame of the National Seismic Resistant Code. For the present situation of the Limnos earthquake and considering that it is a moderate earthquake, for the earthquake engineering purposes the calculated PGA values at longer distances show a rapid decrease compared to a possible extension of the curves, which can be attributed that the broader Aegean area is an area of high attenuation (ex. Hashida et al., 1988).

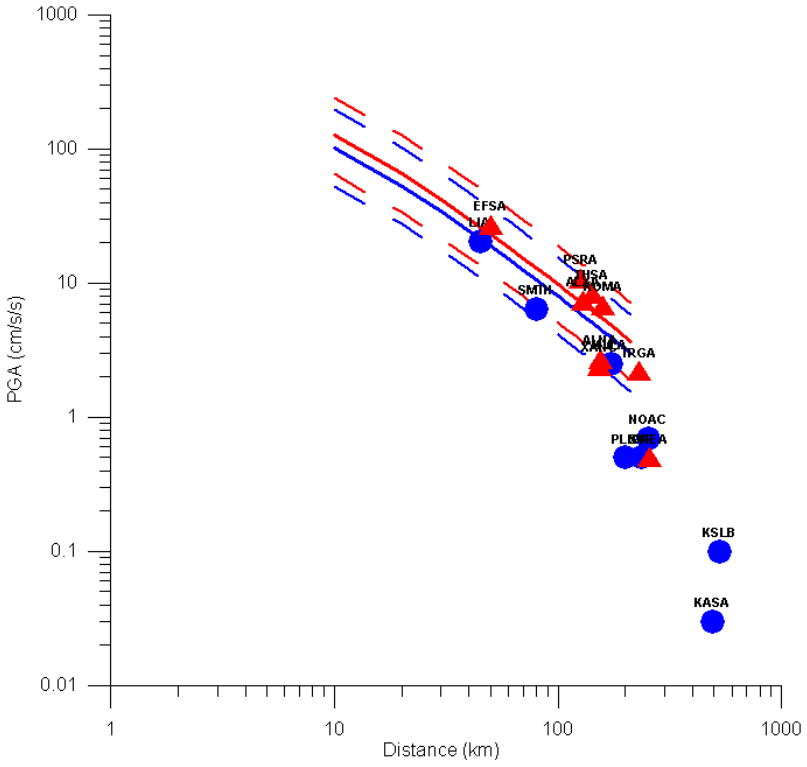

Figure 5. Graph for comparison of the calculated PGAs and the proposed Greek attenuation relationships (Skarlatoudis et al., 2003; Danciu & Tselentis, 2007). The curves refer to a surface, strike-slip earthquake of magnitude Mw5.7. The blue lines and blue points represent rock sites and the red lines and red points the soil sites, respectively. The dashed lines represent the standard deviation of used relationships.

References

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Hashida, T., Stavrakakis , G. & Shimazaki, K. 1988. Three-dimensional seismic attenuation structure beneath the Aegean region and its tectonic implication. Tectonophysics, 145: 43-54.

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