This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No [308417]".

New Directions in Seismic Hazard Assessment through Focused Earth Observation in the Marmara Supersite

Grant Agreement Number: 308417
co-funded by the European Commission within the Seventh Framework Programme
THEME [ENV.2012.6.4-2]
[Long-term monitoring experiment in geologically active regions of Europe prone to natural hazards: the Supersite concept]

D4.3

Report on the high-resolution monitoring in the Sea of Marmara using land-based arrays

Project Start Date	1 November 2012
Project Duration	42 months
Project Coordinator /Organization	Nurcan Meral Özel / KOERI
Work Package Number	4
Deliverable Name/ Number	Improvement of Seismic Hazard Assessment for Marmara Region / D5.8
Due Date Of Deliverable	30 April 2016
Actual Submission Date	15 May 2016
Organization/Author (s)	KOERİ /Prof.Mustafa Aktar

Dissemination Level		
PU	Public	
PP	Restricted to other programme participants (including the Commission)	
RE	Restricted to a group specified by the consortium (including the Commission)	
CO	Confidential, only for members of the consortium (including the Commission)	

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1. Seismic Data from PIRES Network

The PIRES network includes 17 stations of weak motion velocity transducers installed on Prince Islands stations by joint cooperation of GFZ and KOERI. The stations constitute the closest observation positions for the Marmara Sea Branch of the North Anatolian Fault. The stations are distributed over 7 islands, with Two arrays of 5 station each installed on the islands of Yassiada and Sivriada. The data transfer from the stations was initially was done by off-line approach and then converted to on-line during the first year of the project. The online data transfer from PIRES network was fully implemented during the three final years Marsite Project. The performance of the data transfer was not totally satisfactory at the early stages of the on-line operation. There were sporadic interruptions of the data link due to various technical problems. The interruptions created holes in the stored data and were not always filled in. The main drawback for the real-time data transfer is the remoteness of the stations location and therefore difficult access to the normal coverage area of GSM operator. The other problem was the lack of bootstrapping facility in the modems which occasionally were halted. All these drawbacks were partly eliminated by changing the communication infrastructure (including the modems and the antennas) during a second stage of upgrading in April 2014. New modems used 3G transmission which improved the data transfer bandwidth and quality. The data recovery was partly improved by the off-line transfer of the data by occasional visits to the stations sites. Figure 1 gives a graphical representation for the time evolution of the performance for each station during the upgrading period. The y-axis shows the data gap in seconds during a time interval of 1 hour (varies between 0-3600). A general view shows clearly the improvement in performance observed after March-April 2014 where the modem upgrading took place. At later stages of the project, namely in June 2015, the network configuration was subject to a significant modification. The data collection had to be stopped for stations on the Yassiada islands, due to a major construction activity for the development of a conference center. The stations on these islands had to be dismantled totally. There were similar plans for the Sivriada, however since the construction activities on this island did not started within the duration of the project the data wss continued to be

collected. The whole of the collected data is stored at MATSITE database. It consists of 3-components waveforms, all sampled with 200 Hz. Two of the stations have broadband data, where else the remaining are short period data with 4LC sensors of 1 Hz natural frequency. The data is stored both in terms of the raw data and also in sac format. Only the sac format is available for the end user. The sac data for the end user are arranged in files of 1 hour, for each component and for each station. The structure of the database is arranged in hierarchical directories of years, months and days. Presently work is continuing for transforming the whole data into seed format.

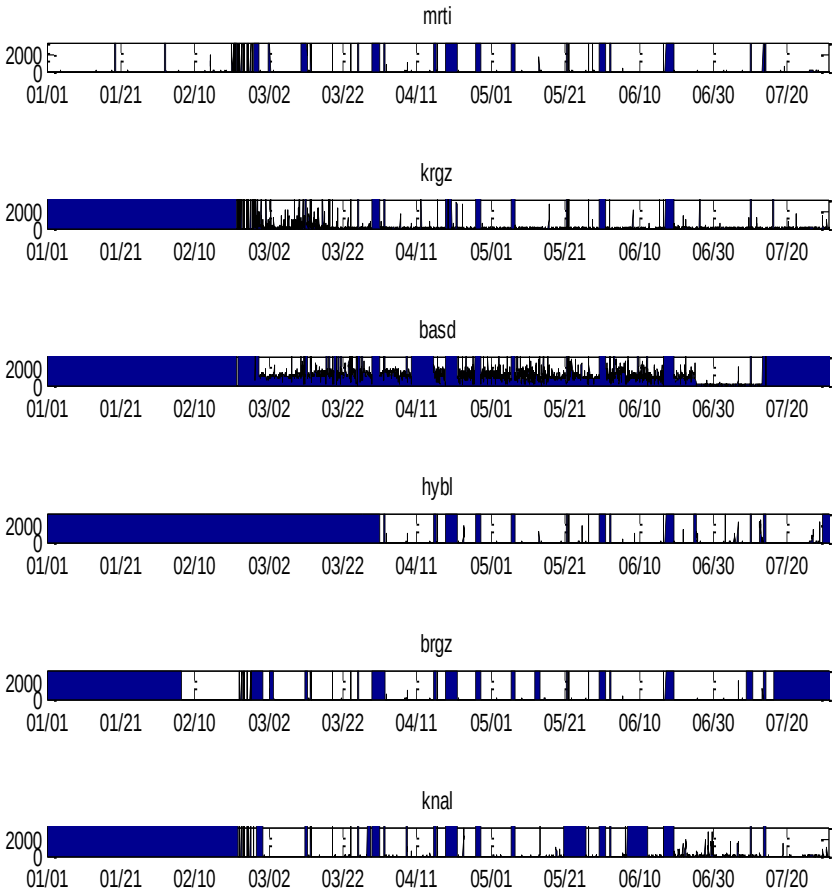

Figure 1. Operating efficiency for 6 stations of PIRES network, distributed on various islands. The example above is given for a period of 7 months starting by 1st January 2014, where the communication infrastructure is

updated. The performance for the total is measured as 61.8%, but it was improved significantly after the upgrading. The best station performance is MRTI by 90% of transmission time. The worst is the NRTH where the performance is below 6%. This station suffers from the location, which is oriented in the direction of north and therefore depends on the availability of the weak GSM signal in that direction. The performance is 50% for the first 3 months of the year where maintenance was practically non-existent. There were at least 4 stations where the transmission performance was below 10%. In the second part of 2014 the performance improved and reached 75%. Only station NRTH was totally off, and therefore lowered the total network performance. All the remaining stations were performing above 70%.

2. Reciever Functions

This task also includes the study of receiver functions for teleseismic waves recorded at all 17 PIRES stations. We have also added other local stations that are operated by KOERI, within the framework of National Seismic Network. We collected all recordings of teleseismic events above moment magnitude Mo>5.5, located at a distance between 30-90^0. We also collected events that were recorded before the starting of the MARSITE project. In total, approximately 1500 teleseismic events were collected between 2006-2015 from a wide range of epicentral distances. We have rotated the components to vertical, radial and transversal and low pass filtered with cut off frequency of 8 Hz. The receiver functions were calculated in time domain using iterative deconvolution technique suggested by Ligorria and Ammon (1999). The azimuth spans the whole range between 0-360^0, but in an irregular fashion. It is clearly seen that most seismic sources are located in Japaneese subduction (40^0-70^0) and Java-Sunda subduction (100^0) zones. As an example, the receiver functions calculated for the station SCRP on Yassiada are shown as example in Figure 2 . Many conversions are clearly seen in the receiver functions and their quality is better in some azimuths. We have also observed certain arrivals in the transversal component, which indicate the effect of 3D structure that deviates from 1D models. Work concerning a more detailed analysis and in particular inverse modeling of the receiver functions is still continuing.

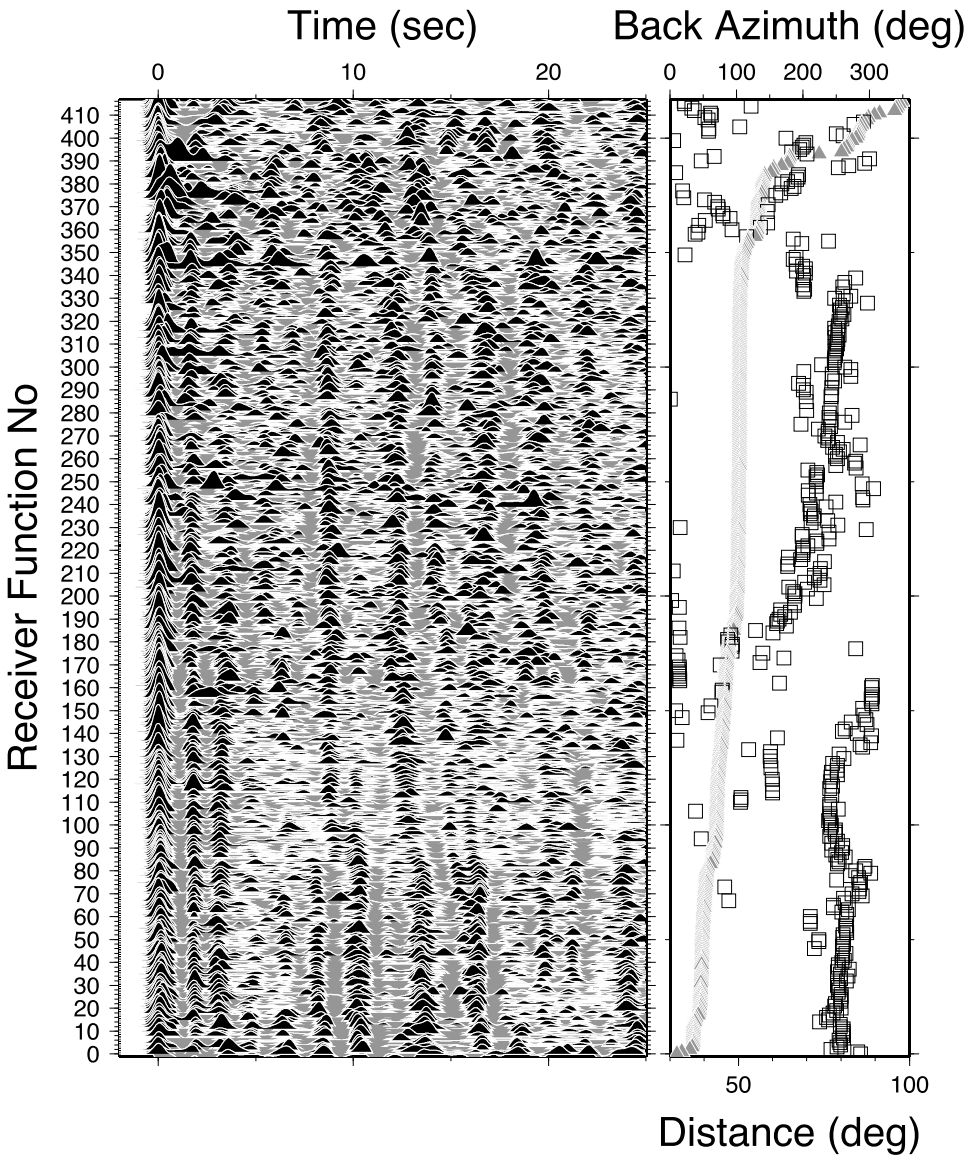

Figure 2 Receiver functions calculated for the station SCRP on Yassiada, part of the PIRES array. Originally the number of receiver functions is of the order of 1500. These are filtered on the basis of the degree of fit in the deconvolution stage. Only 415 of them are shown in the figure. The values of the azimuth and distances are shown on the right hand side of the receiver functions.