Spatial surface wave spread network from Ambient Noise correlation

Z. Zheng, T. Fujiwara, N. Sakurai, K. Yoshizawa and K. Yamasaki

Tokyo University of Information Science, 265-8501 Japan

(TEL:81-43-236-4652; FAX:81-43-236-4652)

(zhengzy@edu.tuis.ac.jp)

***Abstract*:** We computed the correlations of the ambient noise correlation of 66 stations of F-NET (Broadband Seismic Network JAPAN) that were apart from tens to hundreds kilometers. By stacking cross-correlation functions of ambient noise, we can extract the coherent part of each two stations. Through quantitative analysis of the magnitude of these extracted pluses of ambient noise correlation from any two stations, we construct a network that may reflect the main surface wave spread characters in spatial field.

Keywords: seismic noise, complex network, tomography, correlation function.

I. INTRODUCTION

Campillo and paul Campillo [1] found in 2003 that the stacking cross-correlations function of codas is similar the Green function tensor. Then many researches about the cross-correlations function of seismic waves and network method were carried Bensen et al [3], Shapiro et al [4], Zheng et al [5], Shiraishi et al [6] and Weaver[7]. Recently, some research indicated that these ambient noise correlations may concern with big earthquakes Xu[2]. In our research we analyzed the big area in space and time scale, found that the cross-correlations based on ambient noise may effect by big earthquakes. The big earthquakes have a effect that destroy the stability of cross-correlation in a wide area.

II. DATA AND METHOD

We used the 2003 66 stations of F-net data in 1HZ. First, the "one-bit" method (3) was used to remove earthquakes and other contaminants from seismic waveform data. We divide the wave of each day of a station into 1440-s-long segments with overlap of 300 s.

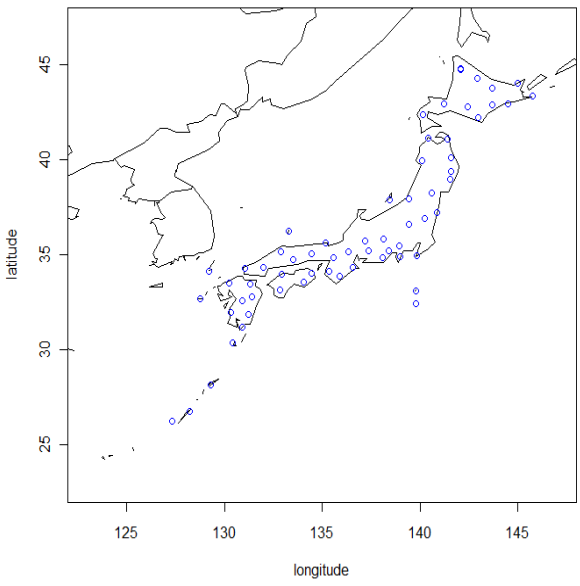

Fig. 1. The F-NET stations that was used in this research. (66 stations)

Then we computed the cross-correlations between these truncated signals, next each pairs' cross-correlations function were stacked to give the signals. The samples were show in Fig. 2. When SNR > 30, we may define a link between this two stations. All links construct a network as Fig. 3, her we call this networks is "seismic ambient noise network".

III. RESULTS and DISCUSSION

From Fig. 2 we can found that the correlation function peaks are changed in different day. Tough we don't know the reason of these dynamical changes, in our research we could show that the big earthquake may give some influence to these links. In order to quantitatively show this influence, we sum the links number of "seismic ambient noise network" of each day in 2003, the links numbers graph was show in Fig.4 , from this graph we can found that when each big earthquake (except aftershock) is occurred the links number will go down sharply. The second earthquake in September is an aftershock.

VI. CONCLUSION

In our research, we show the Ambient Noise correlations in the big spatial scale as a network. The network show a very dynamics characters. We checked the total links number in each day of the network.

The result shows that the number would down precisely when the big earthquake occurred. It indicate one possibility for the earthquake forecast.

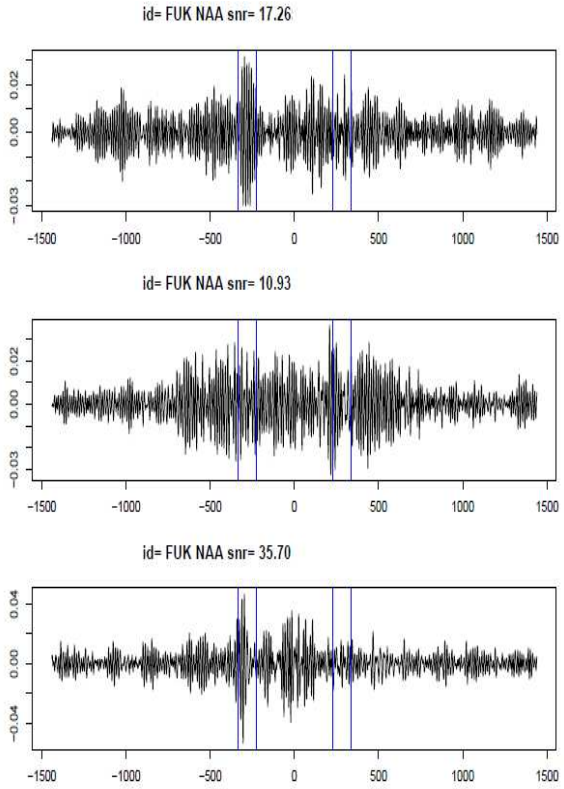

Fig. 2. The sample correlation functions of FUK and NAA stations. Each one indicate one days correlation, this graph shows 3 continues days correlations. The blue vertical lines show the predict maximum and the minimum group arrival times.

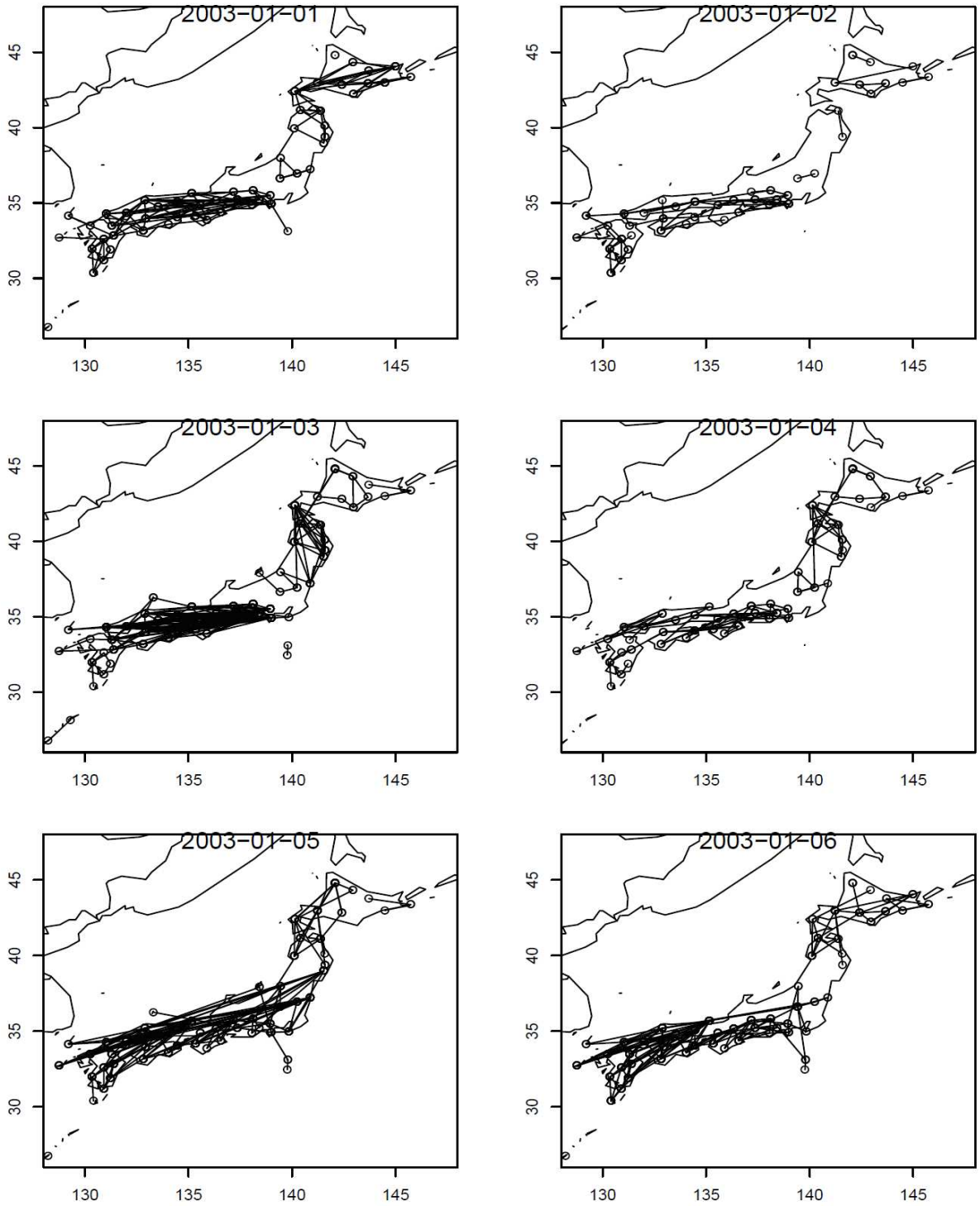

Fig. 3. The example network maps of 6 days in January 2003. The links are changed dynamics.

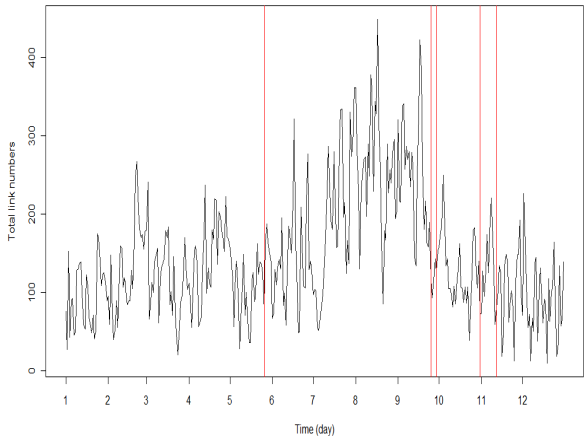

Fig. 4. The total links numbers in each day of 2003. The red vertical lines indicate the main earthquakes bigger than magnitude 6.5 in Japan.

Acknowledgment

Thanks for the support of Grant-in-Aid of Research project for the sustainable development of economic and social structure dependent on the environment in eastern Asia.

REFERENCES

[1] Campillo M and Paul A (2003), Long-Range Correlations in the Diffuse Seismic Coda. Science 299: 547-549

[2] Xu Z and Song X (2009), Temporal changes of surface wave velocity associated with major Sumatra earthquakes from ambient noise correlation. PNAS 106: 14207-14212

[3] Bensen G, Ritzwoller M, Barmin M, et al. (2007), Processing seismic ambient noise data to obtain reliable broad-band surface wave dispersion measurements. Geophys. J. Int. 169:1239-1260

[4] Shapiro N, Campillo M, Stehly L et al. (2005), High-Resolution Surface-Wave Tomography from Ambient Seismic Noise. Science 307: 1615-1618

[5] Zheng S, Sun X, Song X et al. (2008), Surface wave tomography of China from ambient seismic noise correlation. Geochemistry Geophysics Geosystems 9

[6] Shiraishi K, Matsuoka T, and Kawanaka T (2008), Review of Seismic Interferometry. Jour. of Geography 117:863-869

[7] Weaver R (2005), Information from Seismic Noise. Science 307:1568-1567