Crustal structure beneath Thailand using ambient noise field: preliminary results

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1.Introduction

Thailand is located in inner shelf of Eurasia continental plate. Two micro continent terranes were defined as Shan-Thai (ST) in west and Indochina (IC) in northeast. Between these two terranes Lampang-Chiang Rai (LC) and Nakhon-Thai (NT) blocks were developed during the collision between ST and IC. Cenozoic basin was developed with E-W extension tectonics. The crustal thickness of ST is about 30km, while that of IC is about 40km.

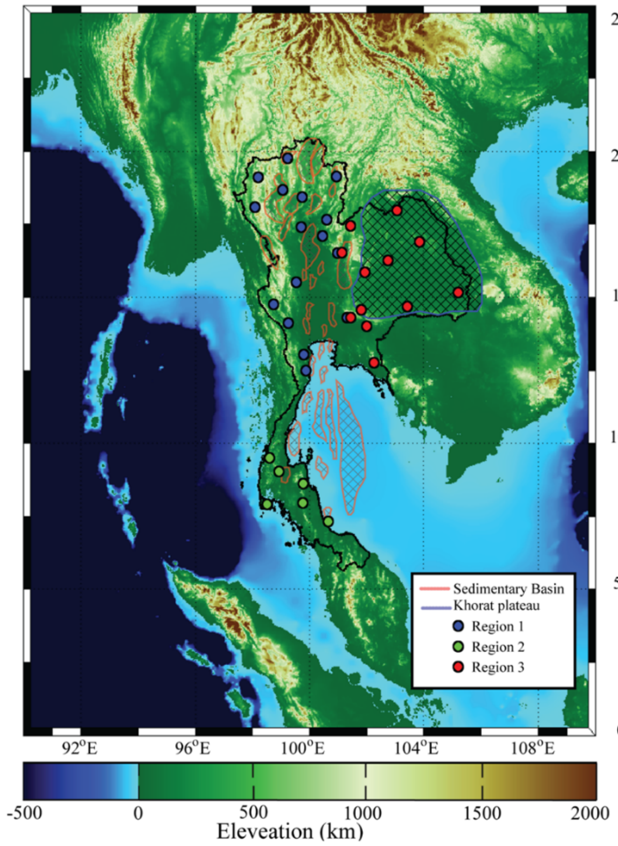

Figure 1. Map show topography of Thailand including sedimentary basin and Station group in 3 regions.

2 measurement

We used 4 years long three components seismic data of Thailand Meteorological Department (TMD) recorded during 2011-2014. TMD network. They are composed of 6 Trillium 120, 9 of Trillium 40, 11 of GEOTECH-KS2000M, and 14 of GEOTECH-S13 (Short period). We conducted the standard noise cross-correlation processing (Shapiro and Campillo 2004; Bensen et al. 2007; Nagaoka et al., 2012). As the first step for single station data, the data for each station were 1) windows in one-day length 2) removed mean and trend 3) resampling into 0.25 second and 4) spectral whitening.

For each daily data, we cut the waveform into hourly data, rotate coordinate from ZNE to ZRT from stations geometry. We, then, calculated the cross-correlation function (CCF) between each station pair, and stack cross-correlation waveform together. Based on the tectonic setting and the distribution of station, we categorized all the seismometers into 3 Regions (see Figure 1). Region1 is located in ST and LC (Northern and Central areas). Region 2 is located in the Southern area isolated from Northern ST. Region 3 includes Khorat plateau and the border at NT.

Frequency-Time analysis (FTAN) was applied to each CCF (Levshin, 1996; Bensen et al. 2007). We pick the maximum lag time of the wave envelope function of CCF at each center frequency of Gaussian filtered for a measurement of the group speed.

In each region, we also measured phase velocities by Spatial Autocorrelation (SPAC) method with assumptions of 1-D structure and isotropic arrivals of Rayleigh waves. For the measurements, we measured phase velocities at a frequency by pick of the maximum Variance reduction between synthetics and data, which is defined as

$$VR(c,\omega)=\frac{1}{2}\left[1-\frac{\sum_{ij}\left[\varphi_{ij}^{obs}(c,\omega)-\varphi_{ij}^{syn}(c,\omega)\right]^2}{\sum_{ij}\left[\varphi_{ij}^{syn}(c,\omega)\right]^2}\right]_{Radial}+\frac{1}{2}\left[1-\frac{\sum_{ij}\left[\varphi_{ij}^{obs}(c,\omega)-\varphi_{ij}^{syn}(c,\omega)\right]^2}{\sum_{ij}\left[\varphi_{ij}^{syn}(c,\omega)\right]^2}\right]_{Vertical},$$

where φ_{ij}^{obs} is synthetic Green's function, φ_{ij}^{obs} is observed Green's function. A moving average method with frequency width of about 0.03 Hz was applied for the observed phase velocity dispersion curve in order to stabilize the measurements in each region.

3. 1D dispersion inversion and 2D inversion for group velocity map

In order to construct a reference velocity model in each region, the measured group velocities and the phase velocities were inverted for obtaining 1-D S-wave velocity model. Mean group velocities and the standard deviations in each region were calculated by bootstrap resampling. Then the average group velocity and the phase velocity were inverted for obtaining it. Group velocity maps at period ranging from 6- 24 second were, then, inferred by a linearized inversion (Rawlinson and Sambridge, 2003).

4. Preliminary results and discussion

We found that many of station have data glitches, which make a difficulty to the extraction of micro seismic signal from waveform. The CCFs of radial and vertical component in each region are shown in figure 2. Region 3 has least number of CCF and reveals a complexity in wave propagation. Checker broad tests with grid size 25 kmx25km and anomalies size 80kmx100km were performed using ray paths between the observed pairs of the stations at period 12 second. The tests show that we can detect the anomalies but poorly recover their shapes. The observed ray coverage provides higher longitudinal resolution than latitudinal. Low velocity zones in 2 D group velocity map are match well with basin and geological features.

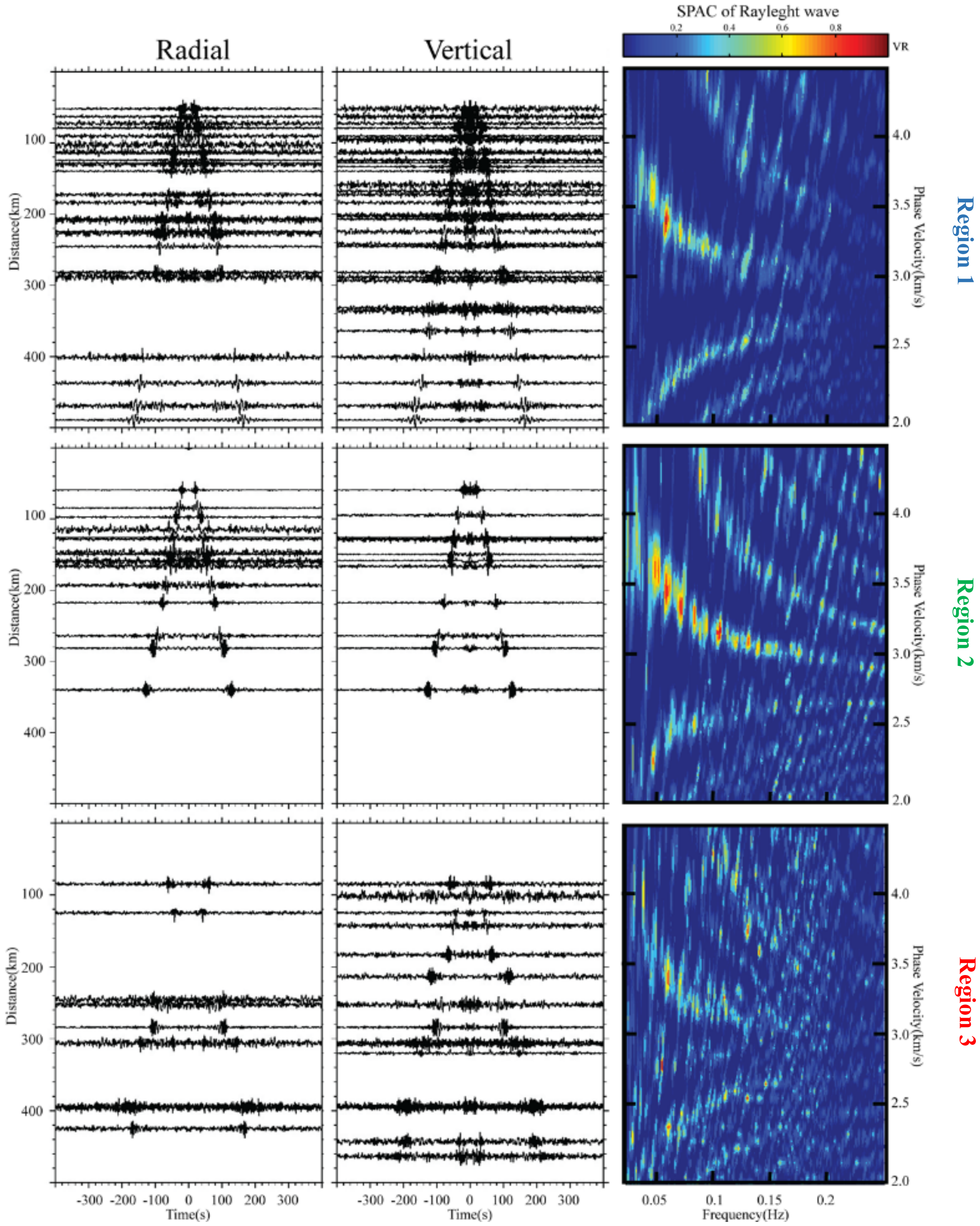

Figure 2. Observed radial and vertical CCFs at each region. Variance reduction from spatial