Comprehensive analysis for the forearc structure and dynamics by using the S-net data

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The forearc area especially in the region under the Pacific Ocean is the frontier of the study on subduction zones. In this area, National Research Institute for Earth Science and Disaster Resilience (NIED) deployed the Seafloor Observation Network for Earthquakes and Tsunamis along the Japan Trench (S-net) which will open a new window to the Science on the structure and dynamics of the subduction zone. The 150 ocean-bottom cabled stations cover an offshore area of about 200 x 1000 km with a station separation of ~30 km perpendicular to the Japan and Kuril trenches and 50-60 km along the trenches. We obtained the continuous S-net velocity and acceleration seismograms from August 2016 to October 2018 which were made available by NIED in October 2018. We report first results of analysis that start with basic analysis of the data.

First, we estimated the direction of the three components of the sensors using the gravity and particle motion of teleseismic Rayleigh waves recorded by the accelerometers. The results show 1 degree or larger steps in the rotation about the axis of the cable for two earthquakes but stable for other periods. The directions of the axes were estimated with the uncertainty of 5 –10 degrees. The data was used to rotate waveforms of each station to N-S, E-W and U-D (Takagi et al., this meeting).

For the shallow structure, the thickness of sediments is estimated by using PS converted waves at the sedimentary basement. The PS-P traveltime difference shows a similar value of 1.3 to 1.5 s for most stations, which corresponds to a sediment thickness of 350-400 m. However, in the outer trench area of the Kuril –Japan trench junction and the inner trench area off Nemuro, thicker sediments are revealed (Azuma et al., this meeting). The cross-correlation analysis of ambient seismic noise suggests multiple velocities of ~1.5 km/s and ~0.3 km/s for 10 s or shorter periods. These two Rayleigh waves can be interpreted as the waves traveling in the sediments and Sea (Takagi et al., this meeting). The traveltime residuals of local earthquakes also suggest the effect of the shallow thin sediments. The P-wave travel time residuals for an existing 3-D velocity model exhibit variations of up to 2 seconds (Toyokuni et al. this meeting) and the residuals of near-shore earthquakes have up to 3 second for the outer trench areas (Okada et al. this meeting). These velocity structures are important for accurate hypocenter determinations (Okada et al. this meeting).

The deeper velocity structure is also investigated using the phase velocity of teleseismic and regional earthquakes. The teleseismic Rayleigh waves data result in a phase velocity of 3.6-3.9 km/s at periods of 20-50 s. The result shows relatively high wave speeds off Fukushima and Miyagi (Ishigami and Takagi, this meeting). The local earthquake tomography also shows a high P-wave speed in the overlying plate off Miyagi. The study also shows improvement of resolution in the offshore area by adding the S-net data (Toyokuni et al., this meeting). The cross-correlation analysis of ambient seismic noise has successfully extracted Rayleigh and Love waves at a period of as long as 30 s that travels among the S-net stations

(Takagi et al., this meeting). The anisotropy of velocity in the overlying plate was also examined by shear-wave splitting measurements. The result shows trench parallel fast direction of shear waves, which is similar to the fast directions in the land area (Uchida et al., this meeting).

For the plate boundary, the repeating earthquakes are identified by the S-net which may contribute to a better understandings of the interplate slip and plate geometry (Uchida et al., this meeting). The accelerometer data of S-net also might have potential to detect slow fault slip in the offshore area, because some of the stations seem to responds to the Earth tide (Takagi et al., this meeting).

Acknowledgements: We thank the NIED staff who deployed the S-net, maintained the network and opened the data to the public.

Keywords: S-net, Subduction zone, Ocean bottom observation