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Determine the Moho depth and sedimentary layer thickness in a subduction zone: Results of receiver function analysis from North Philippines

Cong Nghia Nguyen (1), Bor-Shouh Huang (2), Po-Fei Chen (3), Van Duong Nguyen (4), Chin-Shang Ku (2), Win-Gee Huang (2), Bartolome C. Bautista (5), Ishmael Narag (5), Winchelle Ian Sevilla (5), and Melosantos Arnaldo (5)

(1) National Central University, International Graduate Program for Earth System Science, Taiwan , (2) Institute of Earth Sciences, Academia Sinica, Taipei, Taiwan, (3) National Central University, Taoyuan, Taiwan, (4) Institute of Geophysics, Vietnam Academy of Science and Technology, Hanoi, Vietnam, (5) Philippine Institute of Volcanology and Seismology, Quezon City, Philippines

Receiver function analysis has been widely used to image the subsurface discontinuities from various tectonic settings. In the subduction zone, the results of receiver function analysis could be complicated due to the presence of multiple discontinuities (downgoing slab or low-velocity zone) and complex velocity structure. In this study, we applied two different strategies to investigate the crustal thickness and shallow discontinuities from receiver function in a subduction zone: sequential H-κ stacking (Yeck et al., 2013) and neighbourhood algorithm inversion (Sambridge, 1999). We have used 19 broadband seismic stations from 4 seismic networks to analyze 124 teleseismic events (epicentral distance of 30° - 90°) from 2013 to 2017. The teleseismic P-wave codas at each station have been selected, preprocessed and analyzed using iterative deconvolution to estimate receiver functions. We used sequential H-κ stacking to estimate the shallow sedimentary layer using high-frequency receiver functions and Moho discontinuity using low-frequency receiver function. Independently, neighbourhood algorithm inversion has been used to obtain the S-wave velocity structure. The neighbourhood algorithm inversion optimizes the searching of synthetic receiver function model parameters to produce a group of best-fitting S-wave velocity structure models. In total of 19 stations, 11 stations show a good agreement between two methods with the difference on crustal thickness less than 2 km. The other 8 stations mostly located in the fore-arc region which may explain the higher uncertainty due to the complex structure and the presence of subducting slab. Overall, the results show the sedimentary layer thickness from 0.25 to 2.75 km and a heterogeneous crustal thickness of 14 km to 32 km. This large variation of crustal thickness reflects a transition of subduction zone structure from fore-arc, volcanic zone to continental crust. The results also show a southward thickening trench especially in Mindoro island, which may be caused by the collision of Palawan block into the Philippines.