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Teleseismic body wave phase extracted from ambient noise interferometry constrains the secondary microseism sources of Northern Hemisphere

Yajian Gao[1], Andreas Rietbrock[1], Michael Frietsch[1], Hans Agurto-Detzel[1], Sofia-Katerina Kufner[1], Edmond Dushi[2], Besian Rama[2], Damiano Koxhaj[2], Bernd Schurr[3], and Frederik Tilmann[3]

[1]Karlsruhe Institute of Technology, Geophysical Institute, Karlsruhe, Germany
[2]Polytechnic University of Tirana, Institute of Geosciences, Tirana, Albania
[3]Helmholtz Centre Potsdam, GFZ German Research Centre for Geosciences, Potsdam, Germany

Dense seismic networks are ideally suited to detect daily or even hourly variations of the global secondary microseism via ambient noise cross-correlation beamforming (CCBF) and backprojection (BP) in the slowness-backazimuth domain. We combine the seismic recordings from Hi-net in Kyushu (HINET) network, Southern California Seismic Network (SCSN), and the Large-N AlbaNian TectonIcs of Continental Subduction (ANTICS) network to capture 3-hourly and daily northern hemisphere secondary microseism variations during 2022-2023. We calculate stable ambient noise CC with 300 s lag and 24 substacks per day. In the secondary microseism period band, 1-10s, we detect clear and vigorous high apparent velocity P phase (> 8 km/s) arrivals in 3-hourly and daily stacks for these networks. Both the 3-hourly and daily stacks show clear temporal amplitude and delay time changes in station-pair-distance and symmetry changes of causal and acausal branches, indicating the active evolution of ambient noise source location and strength. For ANTICS, the strongest energy patch emerges with back-azimuth (BAZ) 280°-330° and slowness around 8-10 s/deg. Further two energy patches appear with BAZ 90°-135° and slowness of 4-6 s/deg as well as 0° BAZ and slowness of 5-7.5 s/deg . We back-project the energy from the beamforming to the source location based on IASP91 velocity model assuming the propagation of teleseismic energy as direct P wave (including Pdiff, PKiKP and PKIKP). The back-projection results reveal that the strongest energy comes from the North Atlantic covering a broad arc-shape area (from the northeast coast of the US to the west coast of the UK, and from the south of Greenland and Iceland down to 45°N). The two other energy patches with much higher apparent velocities originate from the south Indian Ocean and the north Pacific near the Aleutian Islands. The 3-hourly and daily changes are tracked and recovered by the CCBF and BP approach for all three networks. The secondary microseism variations in the north Pacific could be improved by the SCSN and HINET whereas the north Atlantic is constrained by ANTICS and SCSN. Some small-scale autumn storms near the Japanese trench are also detected and tracked. Our results are consistent with existing wave height maps and provide a new and cheap observation for hindcasting of the state of the coupling of oceans and the solid earth.