Causes of artifacts in ambient noise surface wave tomography in mantle investigations and ways for their elimination

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Abstract Ambient noise surface wave tomography is a widely used method for determining the velocity structure of the upper layers of the Earth. It is based on the fact that the cross-correlation function (CCF) of noise at two stations, averaged over a long time interval, determines the Green's function of the surface wave. This allows us to estimate the group and phase velocities of surface waves on the paths between stations, which are used in surface-wave tomography. This makes it possible to ultimately estimate the spatial distribution of the S-wave velocities. The method is well-grounded on the assumption that the "noise" is a result of the superposition of surface waves propagating from sources uniformly distributed over the surface. Therefore, the initial data, which are long-period seismic records, are subjected to preliminary processing, an important stage of which is normalization, which allows reducing the effect of earthquakes and averaging the resulting CCFs over a long time interval. At the same time, we have shown that earthquakes mainly contribute to noise at periods above 30-40 s, whose sources are distributed unevenly. Therefore, in cases of clustering of foci in a certain limited area, for example, because of aftershocks after a strong earthquake, the CCF maxima, which determines the dispersion curve of the surface wave, are shifted to shorter times, and the group velocities are correspondingly overestimated. In determining the dispersion of Love waves from CCF transversal (T-T) noise component, the presence of clusters leads to an additional underestimation of the group velocity due to the superposition on the T component (perpendicular to the inter-station path) of the radial component of the Rayleigh wave having a velocity less than the Love wave velocity. Therefore, the anisotropy coefficient, determined from the noise, is underestimated as compared to that obtained from the records of earthquakes along nearby paths. Obviously, to obtain more correct dispersion curves of both Rayleigh and Love waves, it is necessary, for summing the CCFs, to use time intervals in which earthquake clusters would be absent as far as possible.

Keywords ambient seismic noise, Rayleigh and Love waves dispersion curves.

For citation Koroleva, T.Yu., Yanovskaya, T.B., & Lyskova, E.L. (2020). [Causes of artifacts in ambient noise surface wave tomography in mantle investigations and ways for their elimination]. *Rossiiskii seismologicheskii zhurnal* [Russian Journal of Seismology], *2*(2), 58-65. (In Russ.). DOI: https://doi.org/10.35540/2686-7907.2020.2.05

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