Monitoring of seismic-wave propagation and detection of very-low-frequency earthquakes by array analysis

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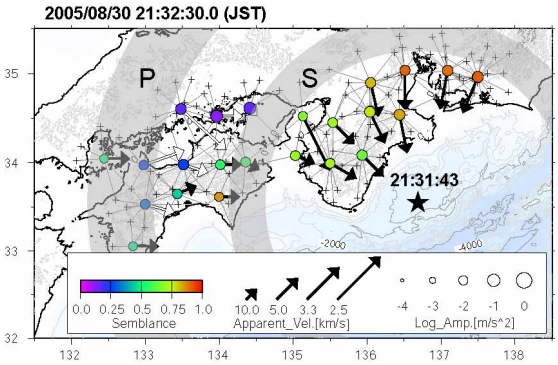
We developed automatically detection method of very-low-frequency earthquakes based on semblance analysis in order to investigate their activities. Seismograms observed by sensitive accelerometer network (Hi-net TILT) with a station separation of about 20 km were analyzed in this study. Band-pass filter with a pass-band of 0.02-0.05 Hz was applied to the original seismograms, and the filtered seismograms were re-sampled with a sampling frequency of 1 Hz. We set reference points and selected stations located within 50 km from each reference point to compose accelerometer arrays. Re-sampled seismograms observed at these stations in each array were analyzed to evaluate semblance coefficient and to estimate azimuth and apparent slowness of propagating seismic waves. Window length and time step of the moving time windows to evaluate semblance coefficient were selected to be 60 s and 30 s, respectively. Azimuth and apparent slowness corresponding to the maximum semblance coefficient in each time step can be estimated by a grid search algorism. We analyzed seismograms observed for an hour from 21:00 to 22:00(JST) on 30 August 2005, for example. Three coherent events with larger semblance coefficient than 0.4 at not less than two arrays were detected in the seismograms. Those events are considered to be coherent waves caused by very-low-frequency earthquakes which occurred along Nankai trough southwest of Kii peninsula. We show one of the results of semblance analysis for a typical very-low-frequency earthquake with a centroid time of 21:31:43(JST). Estimated semblance coefficient, azimuth, apparent velocity, and RMS amplitude in a time step (21:32:30, JST) for each array are shown in Figure. The incident azimuths estimated for almost all of the arrays are consistent with epicenter location. Estimated apparent velocities show a spatial variation depending on epicentral distance. High velocities (5-10km/s) are distributed in Sikoku located about 200-400 km southwest of the epicenter. The high apparent velocities suggest that the observed seismic waves are composed by body waves. On the contrary, low velocities (3-4km/s) are distributed in Kii peninsula within 150 km from the epicenter. It seems that the observed seismic waves are mainly composed by surface waves. This phase identification by apparent velocity can be an effective constraint for event detection and epicenter determination.



図．解析例．各アレイの中心とアレイを構成する観測点の位置を丸印と＋印でそれぞれ示す．星印は本解析によって推定された震央の位置を表す．波群のRMS振幅とセンブランス値を丸印の大きさとカラースケールでそれぞれ表す．また，見かけ速度と到来方向を矢印（センブランス値が0.4以上の場合に黒矢印）の長さと向きでそれぞれ表す．Ｐ波およびＳ波のおおよその到達をグレー網掛け帯で併せて示す．実体波（Ｐ波およびＳ波）の到達域では見かけ速度が大きく，Ｓコーダ波および表面波の到達域と考えられる紀伊半島東部では見かけ速度が小さい．