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Submarine cable drifting and landslide investigation based on ship noise recorded by seismometer

Yi-Chin Lin[1], Jing-Yi Lin[1]

[1] National Central University

After the Ml 5.8 Hualien earthquake occurred the 4 February 2018, the power of the submarine cable seismic and tsunami observation system of Taiwan's Central Weather Bureau (CWB) was shut down for several days, and the attitude of one of the OBS, EOS4, shown 37° rotation and an increase of pressure by an equivalent of 4 meters in depth after the power restoration. To find the actual position of this station, we applied the method of Trabattoni et al. (2020), which calculated the cepstrum based on the time difference between the direct and first reverberation wave of ship noise. However, the flat seabed assumption in this approach may not be suitable for EOS4 which is characterized by a dramatic topography variation. In our study, we developed a Fortran program to calculate the travel time curve by incorporating bathymetry variation and compared it with the result obtained by using active sources to assess the applicability of the program. The result shows the bathymetry variation does affect the OBS relocation. Apart from the position difference, the time difference between the observed and theoretical cepstrum curves could be induced by bathymetry variation. In addition, signal strength indicates the roughness and material of the area around the reflection point. To investigate the drift of EOS4, we select the AIS data of cargo ships within a radius of 30km from the EOS4 for two different periods, which are 2/1-2/4 15:00 and 2/6-2/15, before and after the 2018 ML 5.8 earthquake. We select 27 and 76 ship traces that have significant signals for two time periods, respectively. The minor change in the lateral direction of the cepstrum shows that the site location after the earthquake could not drift for a long distance, but the 0.2s time difference in the vertical direction of the cepstrum could indicate that the site has been buried, which is in the agreement of the pressure change of the station. The energy ratio of the hydrophone and the vertical channel of seismometer decreases at relatively lower frequencies and increases at higher frequencies. This phenomenon also supports our estimation. In addition, based on the cepstrum obtained from the ship tracks for a different direction, we obtained the time difference distribution in two dimensions, which may provide a new approach for bathymetry variation monitoring.

Keywords: Ocean bottom seismometer, Landslide, Cepstrum