Noise removal from vertical component seismograms recorded by broadband ocean bottom seismometers

*川野 由貴[1]、一瀬 建日[1]、川勝 均[1]、塩原 肇[1]、杉岡 裕子[2]
*Yuki Kawano[1], Takehi Isse[1], Hitoshi Kawakatsu[1], Hajime Shiobara[1], Hiroko Sugioka[2]

1. 東京大学地震研究所、2. 神戸大学理学研究科惑星学専攻
1. Earthquake Research Institute, University of Tokyo, 2. Department of Planetology, Kobe University

In an effort to extract as much seismic signal as possible from the existing data recorded by broadband ocean bottom seismometers (BBOBSs), we perform the analysis of noise reduction (Crawford and Webb, 2000; Bell et al. 2015) on the data from Normal Oceanic Mantle (NOMan) project pilot deployment (http://www.eri.u-tokyo.ac.jp/yesman/). We attempt to remove so-called tilt noise that originates from imperfect leveling of seismic sensors and/or tilting of instruments caused by seafloor currents and that results in high coherence between the vertical and horizontal components. We estimate a noise transfer function from the horizontal to vertical components to remove coherent horizontal noise from the vertical component seismograms; we typically apply this procedure to seismograms on a daily basis in a frequency range lower than 0.06 Hz where the coherency is high and the transfer function is stable. As a result of analysis, the highest coherence is larger than 0.99. All five BBOBS stations show significant noise reduction and we reveal a large number of buried seismic signal. At the most remarkable station, the corrected vertical component noise level around 0.03 Hz is just a few dB higher than New Low Noise Model (Peterson, 1993) and strong compliance noise appears around 0.01 Hz. For days of low coherence when we cannot obtain stable transfer functions, we use a mean noise transfer function by averaging stable noise transfer functions of surrounding days as a preliminary analysis. Applying mean transfer functions to each station, we successfully reduce the noise level on the vertical seismic components and reveal more hidden seismic signal even on the low coherence days. We plan to apply this noise reduction scheme to the full set of NOMan BBOBS recordings for the future use of various data analysis. Also, removal of the compliance noise for other existing BBOBS data with differential pressure gauges will be attempted.

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