グリーンランド氷床における広帯域連続地震波形記録を用いた地震波干渉法解析

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Ambient noise cross-correlation analysis using broadband continuous seismic waveform data from the Greenland ice sheet

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The GLISN (GreenLand Ice Sheet monitoring Network) is an international project to seismologically monitor changes in the Greenland ice sheet, by deploying a large broadband seismograph network in and around Greenland. This project is currently managed through joint collaboration by 11 countries for operating 32 seismic stations, although only four of them are on the ice sheet. Japan is a partner country from when the project was launched, and has been sending a field team every year since 2011. A joint USA and Japanese GLISN team has ever serviced three stations on ice sheet (station code: ICESG, DY2G, and NEEM) and also three stations on bedrock at the coastal area (NUUK, SOEG, and DBG), which indicates a great effort of this team among the whole GLISN committee. Especially in 2015, the joint team succeeded in relocating a seismometer at ICESG station, by excavation from 5 m depth below the snow surface.

The GLISN broad-band seismic data (20 sps) is available in realtime via the Iridium satellite network. The data is also open to the public at the IRIS Data Management Center (http://www.iris.edu/ds/nodes/dmc/). In this work, we detected the Rayleigh wave by the ambient noise cross-correlation analysis of the GLISN data, to investigate shallow structure including both ice sheet and bedrock in Greenland.

We used the vertical-component records during Jan. 1, 2015 – Apr. 20, 2015 from four GLISN stations on ice sheet (ICESG, DY2G, NEEM, SUMG). Daily cross-correlation functions (CCFs) for all possible pairs of stations are computed by the following procedure. First, we divide the continuous records into 600-s-long segments with 450-s overlap. Second, we correct the instrument response, eliminate segments with event data or error values, and apply the whitening in frequency domain and banalization in time domain. After that we calculate the daily CCFs by stacking CCFs for each segment (e.g., Shapiro & Campillo, 2004; Takagi & Okada, 2012). The final CCFs can be obtained by stacking all daily CCFs for the whole analysis range.

We found, for example, nearly constant Rayleigh wave group velocity of 2.8 km/s, for the period range of 2-14 s, on the CCF of the NEEM-SUMG pair. We also found that the ambient-noise sources are well corresponded to a known source of microseisms located at the southern tip of Greenland.

References

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