

## Q-factor estimation for Greenland ice sheet using 3-D seismic waveform modeling

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In and around Greenland, 33 seismographs are now in operation by the project “GLISN” (Greenland Ice Sheet Monitoring Network) as an international cooperation with 11 countries. Since the initiation of this project in 2009, broadband and continuous seismic waveform data have been accumulating, and data analyses using seismic interferometry have actively been conducted. For example, Toyokuni et al. (2018) detected a Rayleigh-wave phase-velocity changes over 4.5 years beneath 90 station pairs throughout Greenland, and suggested that the thermal condition (freezing or melting) of the ice-sheet base might be detected using the pattern of the velocity changes. However, the seismic interferometry is a method based on the assumption that the cross-correlation of noise waveforms from two stations yields Green's function between them, when averaged over a long period. However, it is suggested that this assumption sometimes fails due to inhomogeneous distribution of noise sources, etc.

This study first aims to investigate whether this assumption holds for the cross-correlation waveforms from GLISN stations using 3-D seismic waveform modeling. Furthermore, we estimate the seismic Q factors of the ice sheet which explains observations the best, by performing computations several times with different structural parameters.

The scheme we used for the 3-D modeling is “Quasi-Cartesian FDM” proposed by Takenaka et al. (2017). It numerically solves 3-D elastodynamic equation by the finite-difference method (FDM), taking into account the earth's curvature, topography, sea water layer, and 3-D structures of density, seismic wavespeeds, and attenuation. We used realistic ice sheet / basal rock topography data (ETOPO 1) and 3-D crustal / mantle structures (Crist 1.0). We used FX10 Supercomputer System in Univ. Tokyo (216 nodes, 432 processor, 8 threads).

The results are as follows:

- (1) The cross-correlation waveforms obtained by the seismic interferometry show good agreement with synthetic Green's functions for almost all the pairs, showing validity of the seismic interferometry on this region.
- (2) Computations with various Q factors of the ice sheet revealed that  $(Q_p, Q_s) = (20, 20)$  explains the cross-correlation waveforms the best. This is the first example that the high attenuation characteristic of the ice sheet is confirmed for long propagation distance ( $>100$  km).

References:

Takenaka, H. et al. (2017) EPS, 69, 67.

Toyokuni, G. et al. (2018) PEPI, 277, 81-98.

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