EGU23-40, updated on 21 Jan 2024
https://doi.org/10.5194/egusphere-egu23-40
EGU General Assembly 2023

Investigating firn and ice anisotropy around the EastGRIP Camp, North East Greenland Ice Stream, from ambient noise surface waves

Emma Pearce[1], Dimitri Zigone[1], Charlie Schoonman, Steven Franke[2], Olaf Eisen[1,2,3], and Joachim Rimpot[1]

[1]University of Strasbourg, Institut Terre et Environnement de Strasbourg , France (epearce@unistra.fr)
[2]Alfred Wegner Institute, Helmholtz Centre for Polar and Marine Research, Bremerhaven, Germany
[3]Department of Geosciences, University of Bremen, Bremen, Germany

We use cross-correlations of ambient seismic noise data between pairs of 9 broadband three component seismometers to investigate variations in velocity structure and anisotropy in the vicinity of the EastGRIP camp along and across flow of the Northeast Greenland Ice Stream (NEGIS).

From the 9-component correlation tensors associated with all station pairs we derive dispersion curves of Rayleigh and Love wave group velocities between station pairs at frequencies from 1 to 25 Hz. The distributions of the Rayleigh and Love group velocities exhibit anisotropy variations for the along and across flow component. To better assess those variations, we invert the dispersions curves to shear wave velocities in the horizontal (Vsh) and vertical (Vsv) direction for the top 300 m of the NEGIS using a Markov Chain Monte Carlo approach.

The reconstructed 1-D shear velocity model revels radial anisotropy in the NEGIS. Along and across flow vertical shear wave velocities (Vsv) identify comparable velocity profiles for all depths. However, horizontal shear wave velocities (Vsh) are faster by approximately 250 m/s in the along flow direction below a depth of 100 m, i.e. below the firn-ice transition.

This type of anisotropy seems to arise from the alignment of a crystallographic preferred orientation, due to deformation associated with shear zones. The role of anisotropy as e.g. created by air bubbles in the firn and ice matrix, is yet unclear.

Faster Vsh velocities in the along flow direction support that the NEGIS has crystal orientation alignment normal to the plane of shear compression (i.e. ice crystals orientated across flow) within the upper 300 m of the ice stream and are in alignment with the results from other methods. We demonstrate that simple, short duration (2-3 weeks), passive seismic deployment and environmental noise-based analysis can be used to determine the anisotropy of the upper part of ice masses.