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Seismometer Array at Ross Ice Shelf: Understanding ice shelf response to gravity wave excitation

Anja Diez (1), Peter D. Bromirski (1), Peter Gerstoft (1), Ralph Stephen (2), Douglas A. Wiens (3), Richard Aster (4), and Andrew Nyblade (5)

(1) Scripps Institution of Oceanography, University of California, San Diego, USA (adiez@ucsd.edu), (2) Woods Hole Oceanographic Institution, Woods Hole, USA, (3) Department of Earth and Planetary Sciences, Washington University, St. Louis, USA, (4) Department of Geosciences, Colorado State University, USA, (5) Department of Geosciences, Pennsylvania State University, USA

Ice shelves are in direct contact with the ocean, responding to its thermodynamical and mechanical forcing. To better understand the mechanical interaction, an array of 16 broadband seismic stations was deployed on the Ross Ice Shelf (RIS) in November 2014 in a linear array roughly orthogonal to the shelf front. Additionally, a 16-station linear array was deployed roughly parallel to the shelf front. The combined array will collect data continuously over two years, through the austral winter and summer. The orthogonal array spans the region from the ice edge to about 515 km landward towards the grounding line. The focus of the orthogonal array is to measure the response of the RIS to gravity wave excitation, especially those of infragravity (IG) waves (period band 50-350 s). IG waves result from the transformation of ocean swell (< 30 s period) along coastlines. We analyze signals excited by both IG and swell to determine mechanical properties of the ice shelf/water cavity/sediment layer system.
Data over November 19-30, 2014 from three stations about 100 km landward from the ice shelf front were collected at the end of deployment operations. Initial spectral analyses show clear dispersed signals resulting from IG wave arrivals generated along coastlines in the Northeast Pacific. Distinct spectral peaks can be observed at frequencies of 0.5, 30, and 70 Hz, likely related to structure of the ice shelf system.
This initial short duration data set shows great potential to deduce ice shelf properties from seismic signals resulting from gravity wave/ice shelf interactions. The complete year-round data set will allow the determination of spatial and temporal variability of ice shelf properties. The data will also allow us to determine whether the signals observed away from the front result primarily from gravity wave impacts at the shelf front, or are excited below the stations at the shelf base by wave energy penetrating the sub-shelf water cavity.