Automated Data Analysis Software Package for the Antarctic Ice Penetrator Mission

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Outline

• Background
• Mission Concept of Operations
• Software Objectives
• Software Validation/Applications
Background

Ross Ice Shelf and Ice Penetrator x2 (Seismometer, GNSS antenna)
Concept Of Operations

Deployment Airplane

Penetrator Dropped

GPS, seismic, and health data

Iridium satellite

GPS, seismic, and health data

Penetrator

HAYSTACK OBSERVATORY
Objectives

• Develop a software package in python for automatic processing of seismic data in near-real time and for dedicated event post-processing

• Use the software to monitor the response of the RIS to ocean forcings such as swell, infragravity waves, and tsunamis.
Software Development

Seismometer Data → Acceleration → Spectrogram

Seismometer Data → Velocity → Power Spectrum Density

Seismometer Data → Displacement → X-Correlation
Software Validation: Example

• Synthetic data was used to validate software

• Spectrogram and Power Spectrum Density (PSD) of synthetic data

• Input Data: White noise + .1 Hz signal
Software Application: Tsunami

- Software will allow us to identify events like micro-Tsunamis
- Location: iceberg off the coast of Ross Ice Shelf
- Event visible in both spectrogram and velocity plots
Software Application: Seismic Network
Software Application: Wave Propagation

- Cross correlation of data from multiple stations
- Propagation Velocity of an event
- Event: Chilean Tsunami, Sep 17, 2017
- We will be able to determine direction and speed of a propagating wave
Software Application Infragravity Waves

- Infragravity Waves (IG): low frequency waves that propagate through the ice due to ocean forcing
- Frequency range: .003-.02 Hz
- The software will allow us to monitor IG waves
Summary

• Developed modular and scalable seismic data processing software
• Package currently includes signal processing tools such as spectrogram, PSD, and cross correlation
• Software allows detection of ocean-cryosphere coupled events such as IG waves and tsunamis
• Package can be easily expand to include other tools (such as polarization analysis)