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)

[N. Kotary]
Concept Of Operations

Deployment Airplane

Penetrator

Penetrator Dropped

GPS, seismic, and health data

Iridium satellite

GPS, seismic, and health data

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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
  \[\rightarrow\]
  Acceleration
  \[\rightarrow\]
  Velocity
  \[\rightarrow\]
  Displacement

\[\rightarrow\]
Spectrogram
\[\rightarrow\]
Power Spectrum Density
\[\rightarrow\]
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)