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Airborne Acoustic Observations of the OSIRIS-REx Reentry

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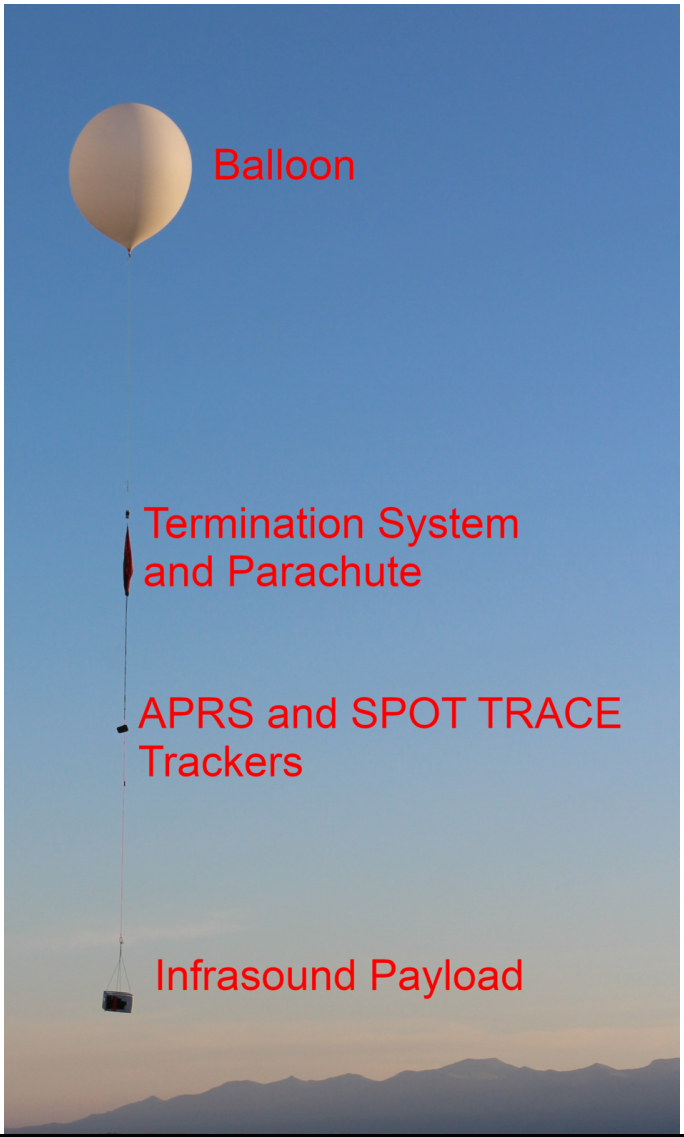
Introduction

Objective: Record an upper atmosphere acoustic source using balloon-borne microbarometers.

- How can we identify acoustic signatures of objects entering from space?
- How does the signal evolve between the stratosphere and the ground?
- What is the reflection coefficient of the Earth's surface?

Balloon Network

A variety of flight systems increase chances of success.



- Two zero pressure balloons
- Two heliotrope balloons
- One high altitude weather balloon
- One low altitude weather balloon
- Two cloudskimmer balloons

Heliotrope "Grand Slam" Launch

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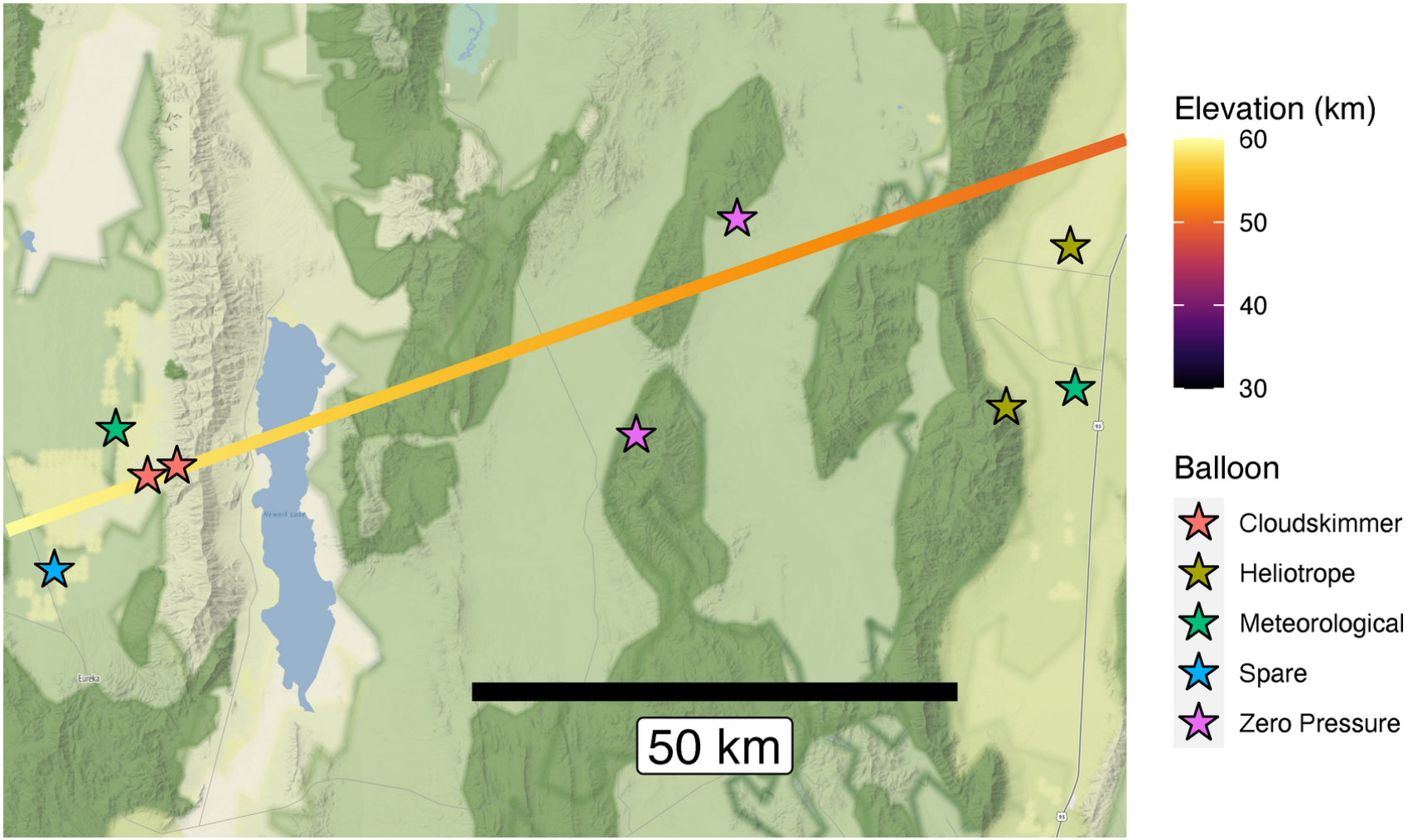
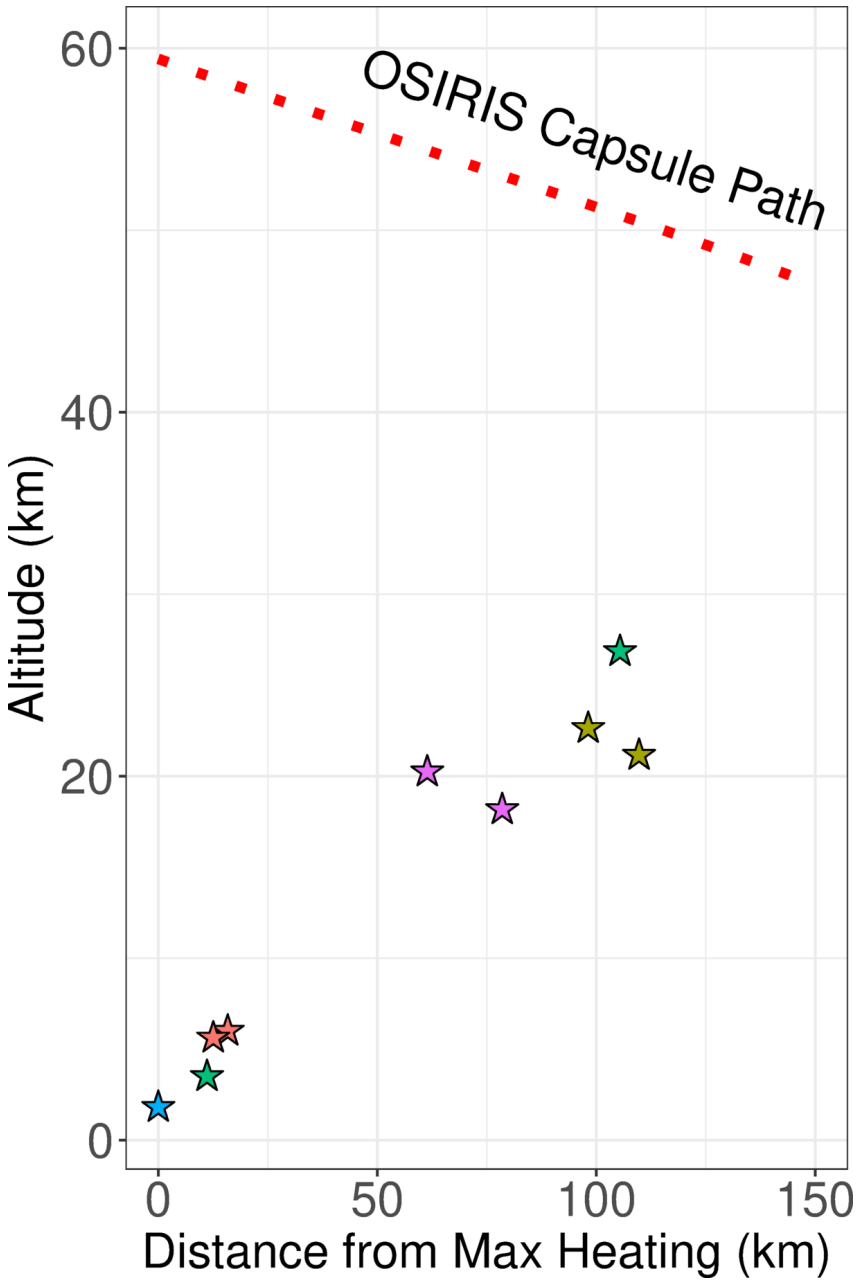
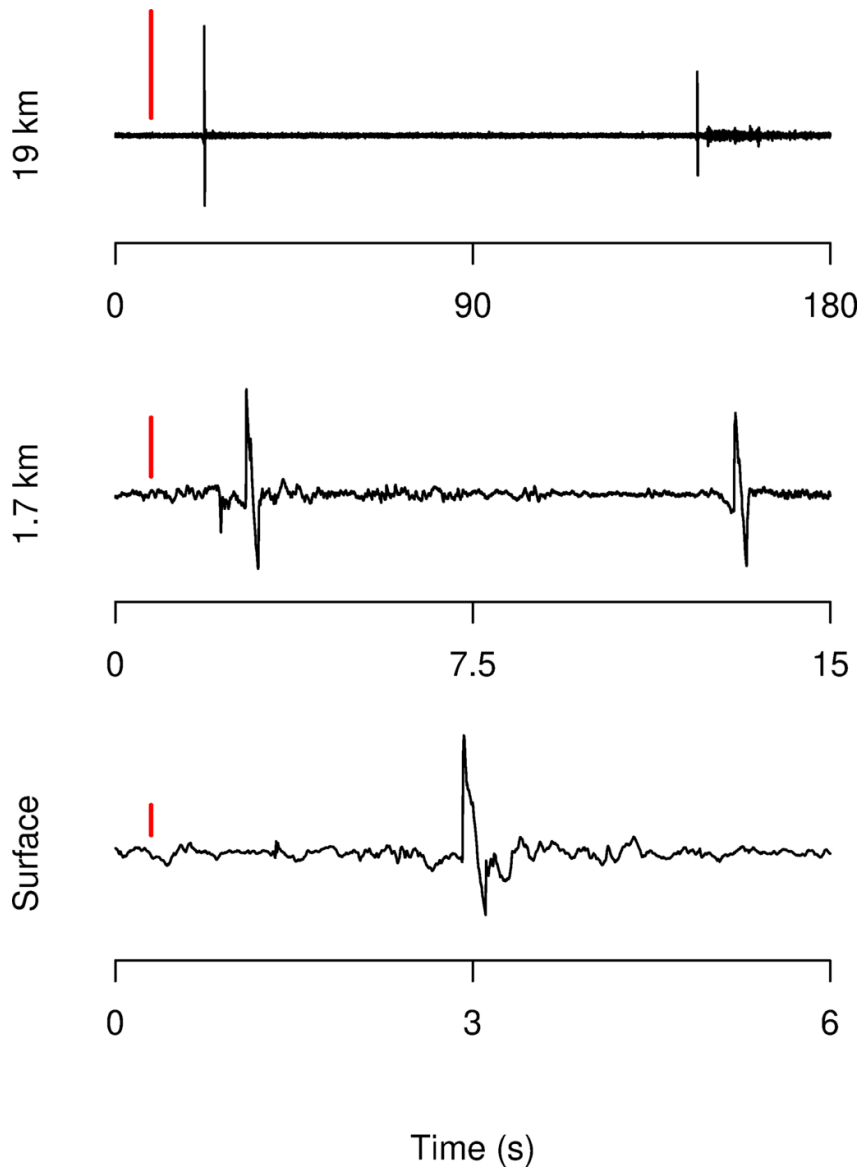
Deployment Map

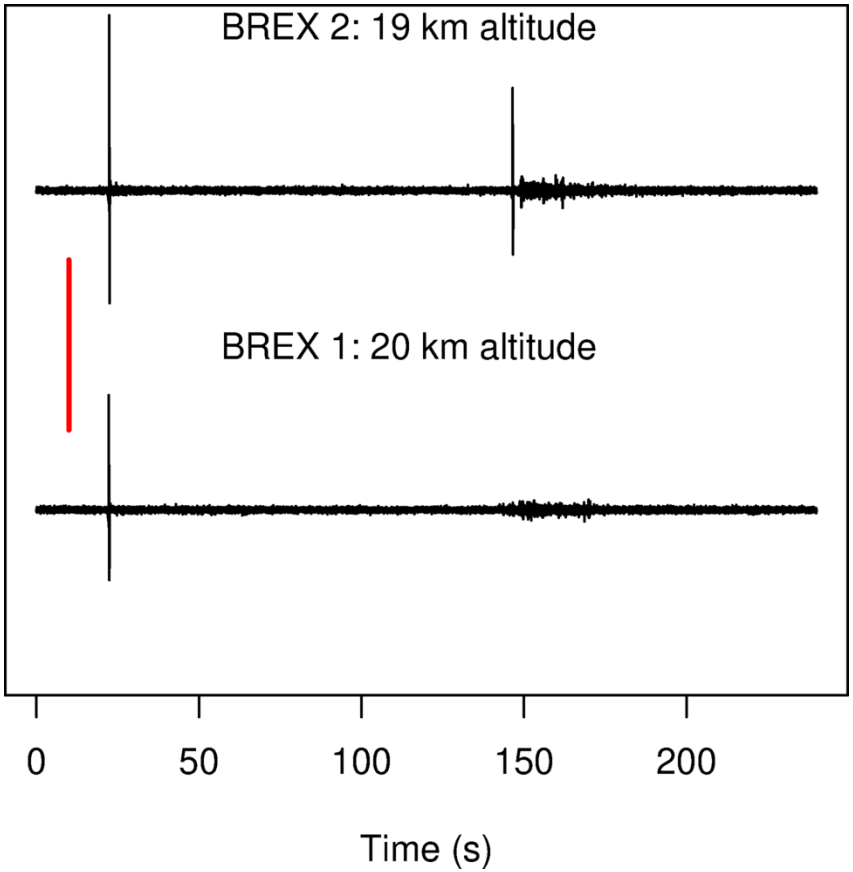


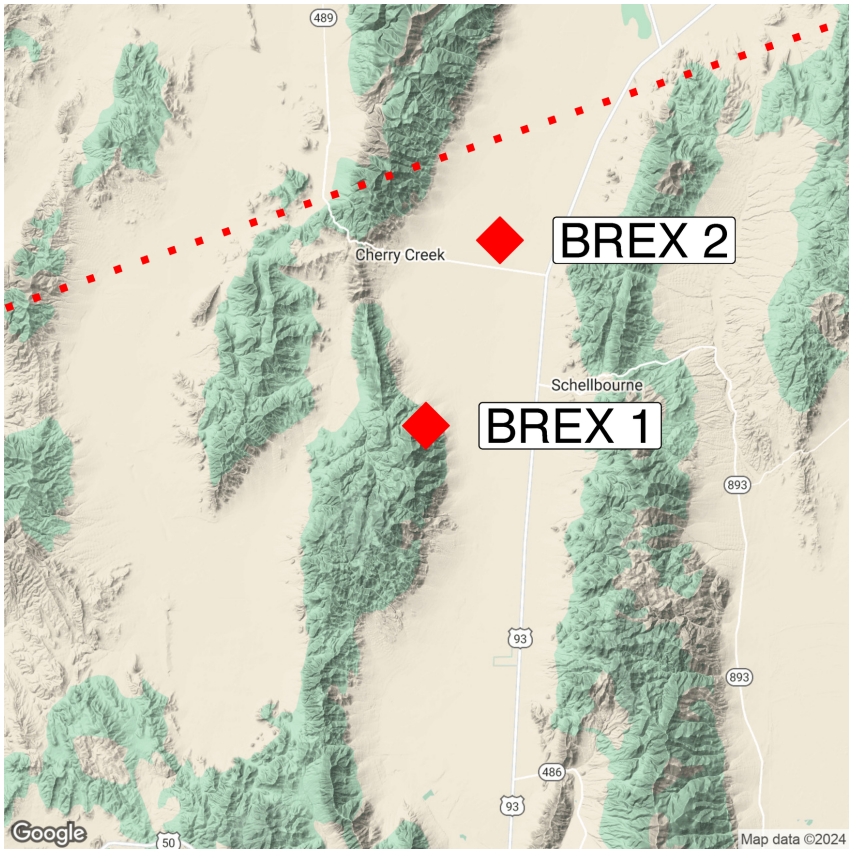
Altitudes and Waveforms



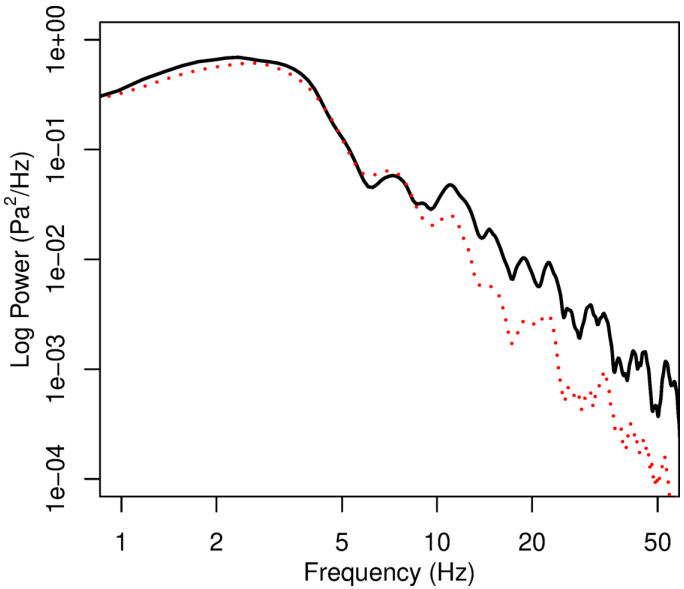


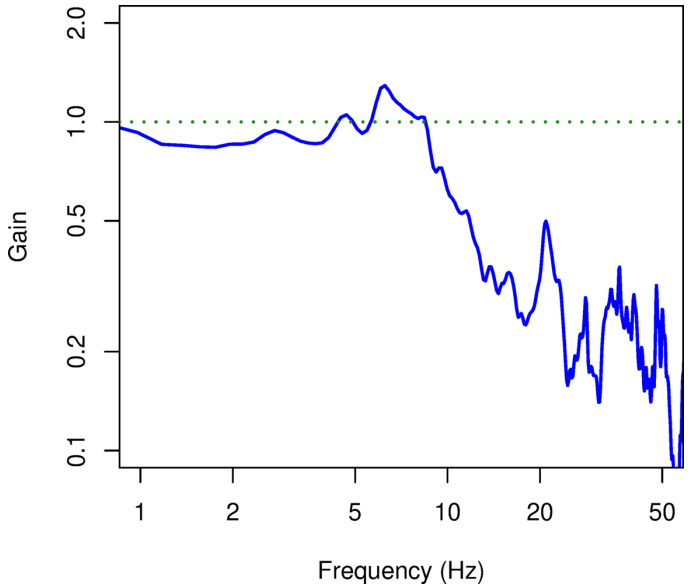
The Case of the Missing Reflection

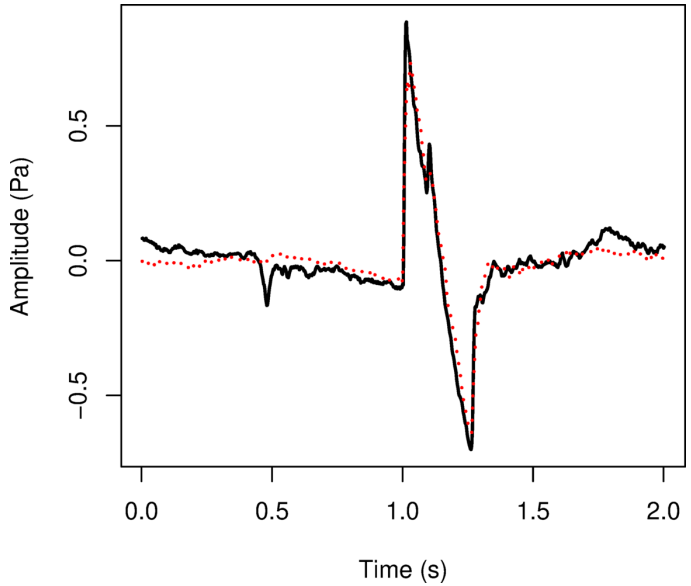




Towards an Empirical Infrasound Reflection Coefficient

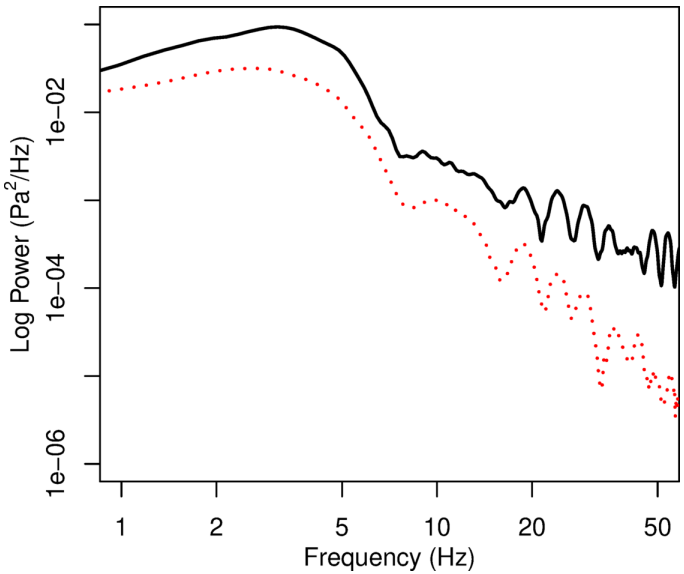


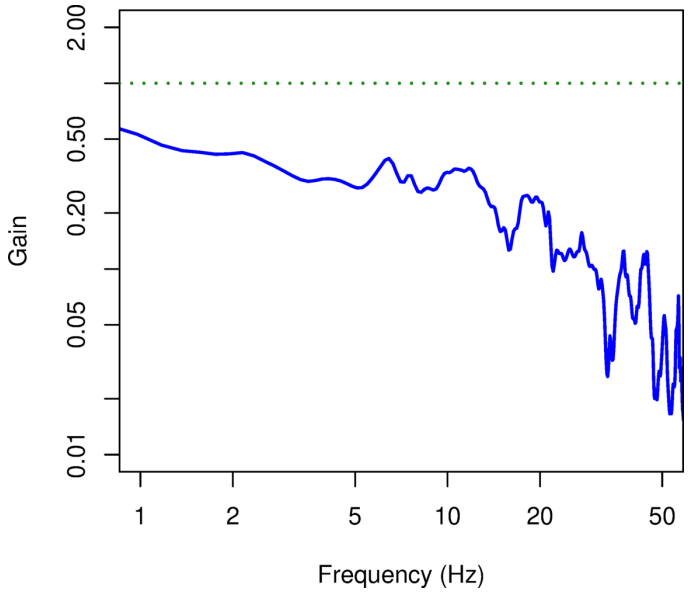


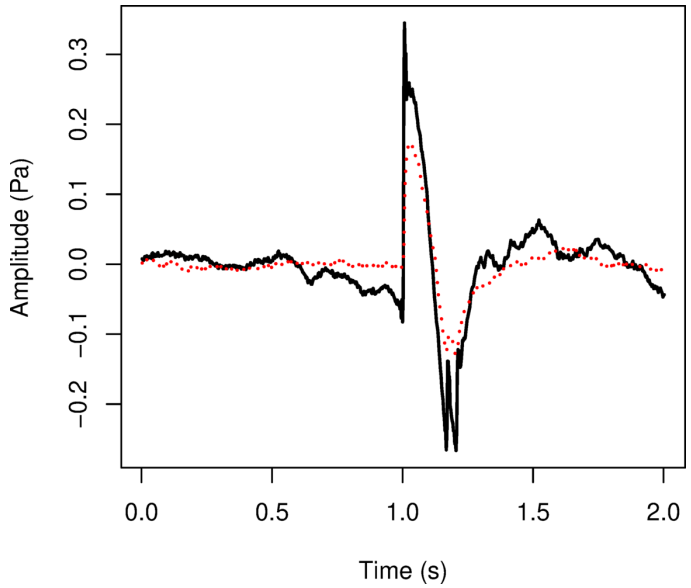


The frequency-dependent infrasound reflection coefficient of the Eureka Valley is analogous to a 10 Hz low pass filter.

High Altitude Measurement







A reflection coefficient measured at 26 km altitude agrees with the result shown previously.

Conclusions

The OSIRIS-REx reentry offered unique insights into acoustic propagation in the atmosphere.

- Direct and reflected arrivals were captured
- Reflection quality depends on topography
- The reflection is a low passed version of the direct signal

Acoustic propagation models should take these observations into account.

Acknowledgments

We thank the citizens of Eureka, Nevada for hosting us and allowing the use of the municipal airport. We are also grateful to the Federal Aviation Administration and the NASA OSIRIS-REx team for their assistance in planning the balloon flights.

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