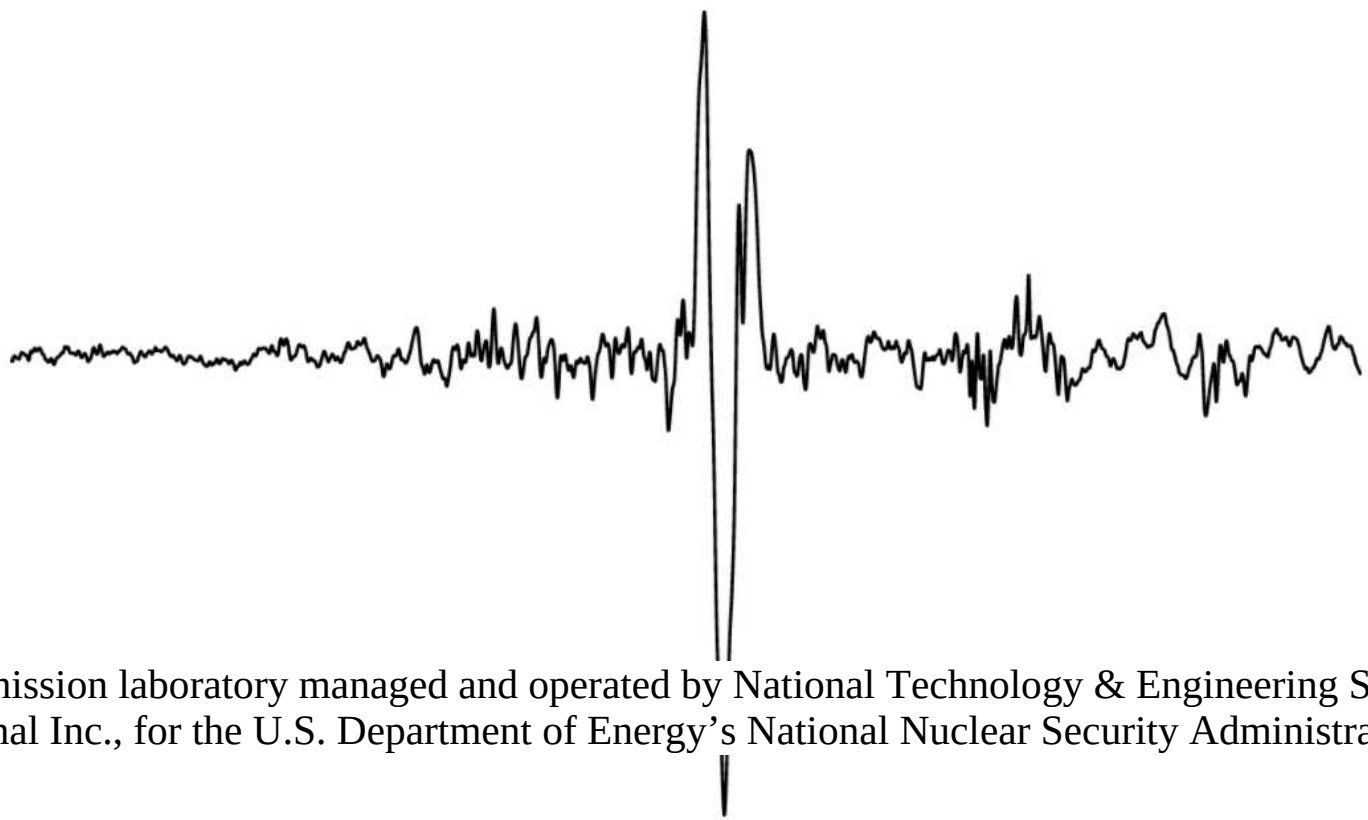
is paper describes objective technical results and analysis. Any subjective views or opinions that might be expres
the paper do not necessarily represent the views of the U.S. Department of Energy or the United States Governm

SAND2020-1800C

Daniel C. Bowman

Sandia National Laboratories

January 28, 2020



oratories is a multimission laboratory managed and operated by National Technology & Engineering Solutions of Sandia,
neywell International Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract

Outline of Talk

Airborne infrasound at SNL

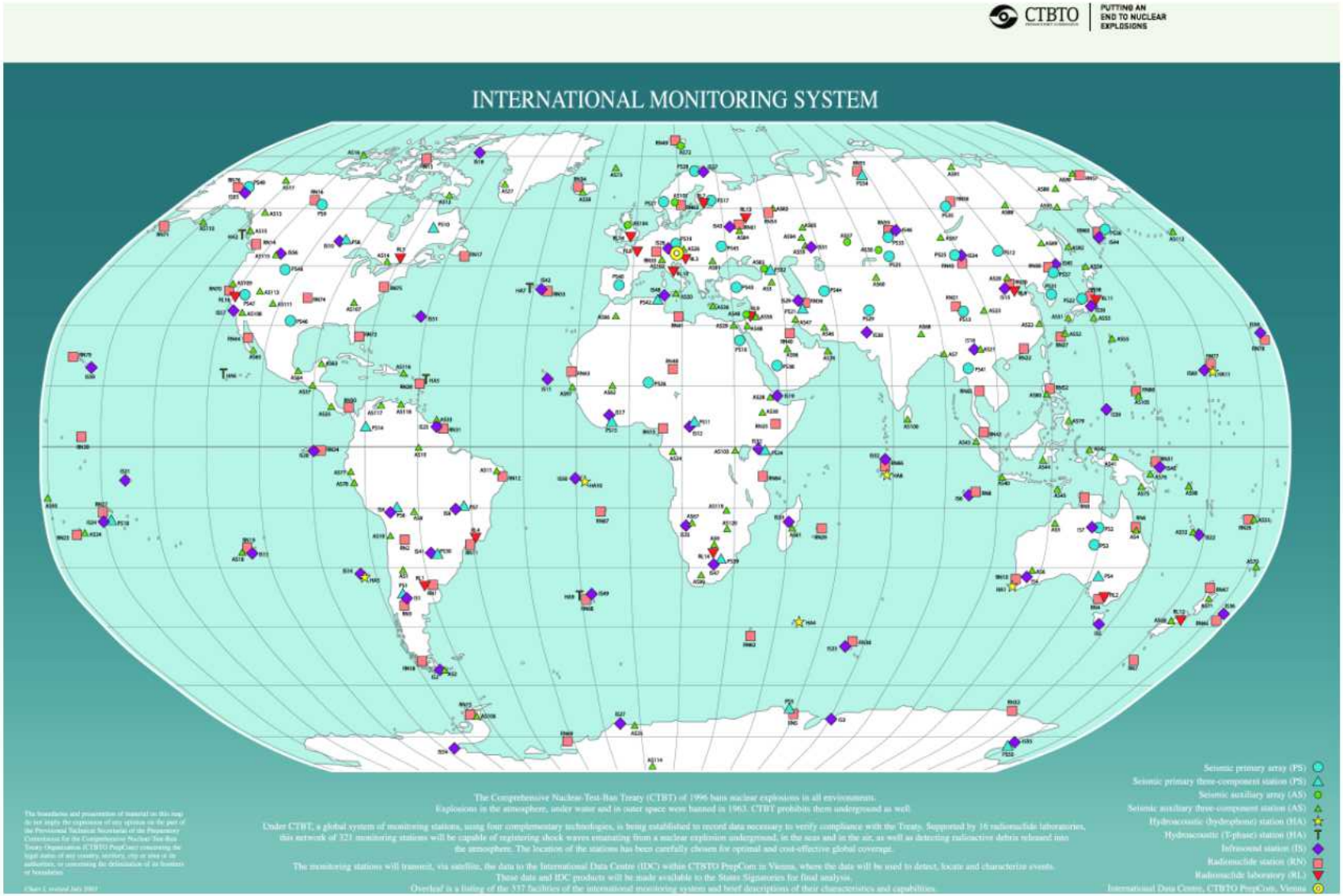
- Mission
- Strategy 1: Deploy against existing experiments
- Strategy 2: Piggyback on long flights
- Strategy 3: Develop collaborations
- Strategy 4: Leverage in-house and local resources

The Heliotrope balloon

Mission

My department researches methods to detect and characterize nuclear detonations using ground and atmospheric assets. **Infrasound is one of the primary means of doing this.**

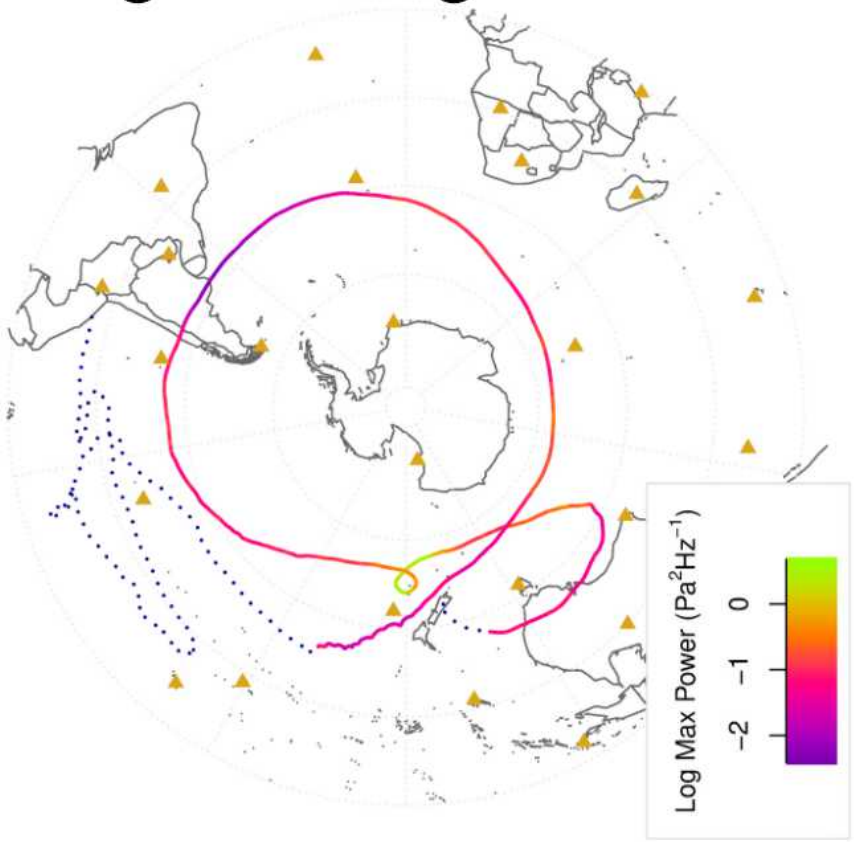
The International Monitoring System



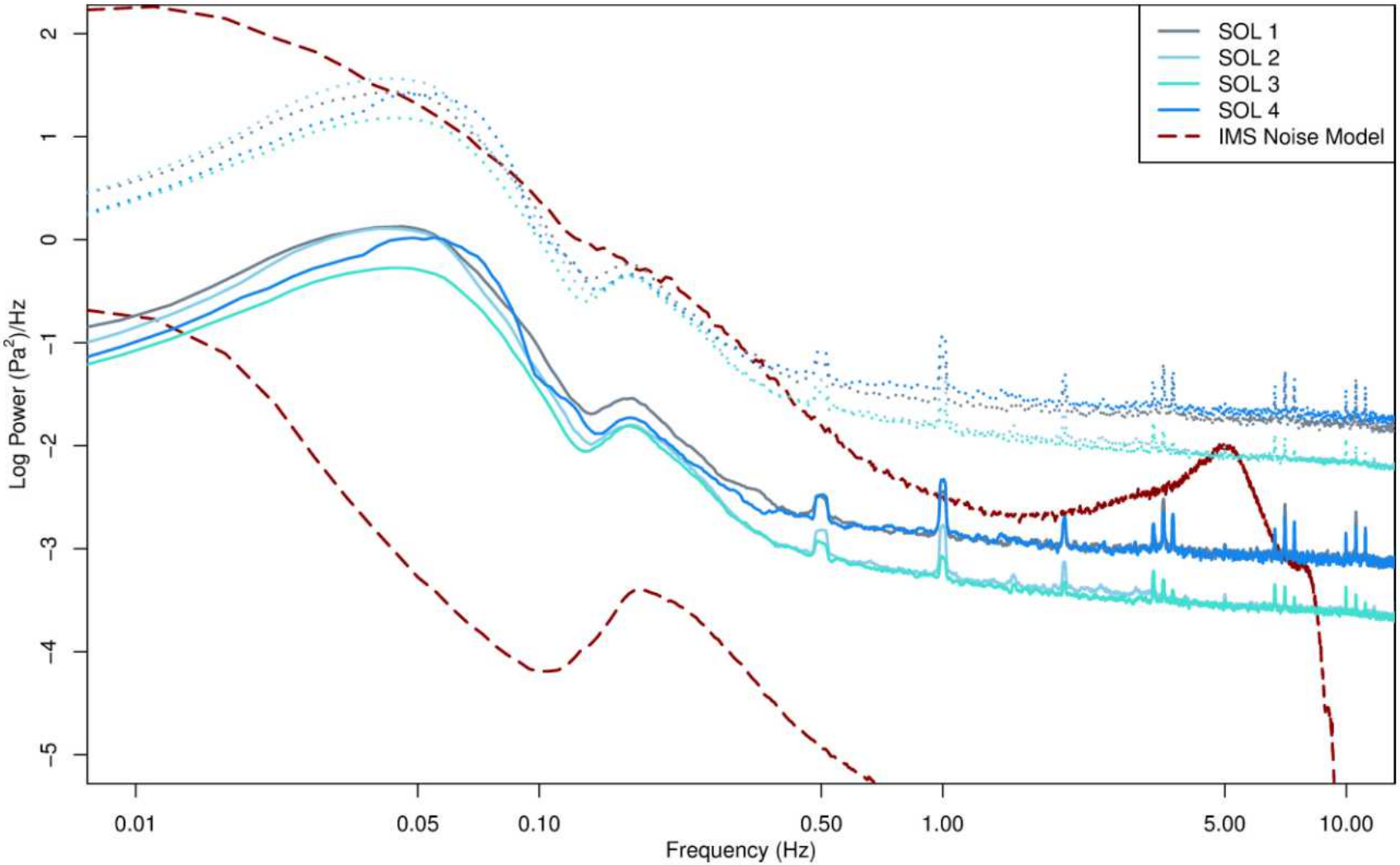
An IMS infrasound station

Balloon infrasound

Balloons can go where ground stations cannot



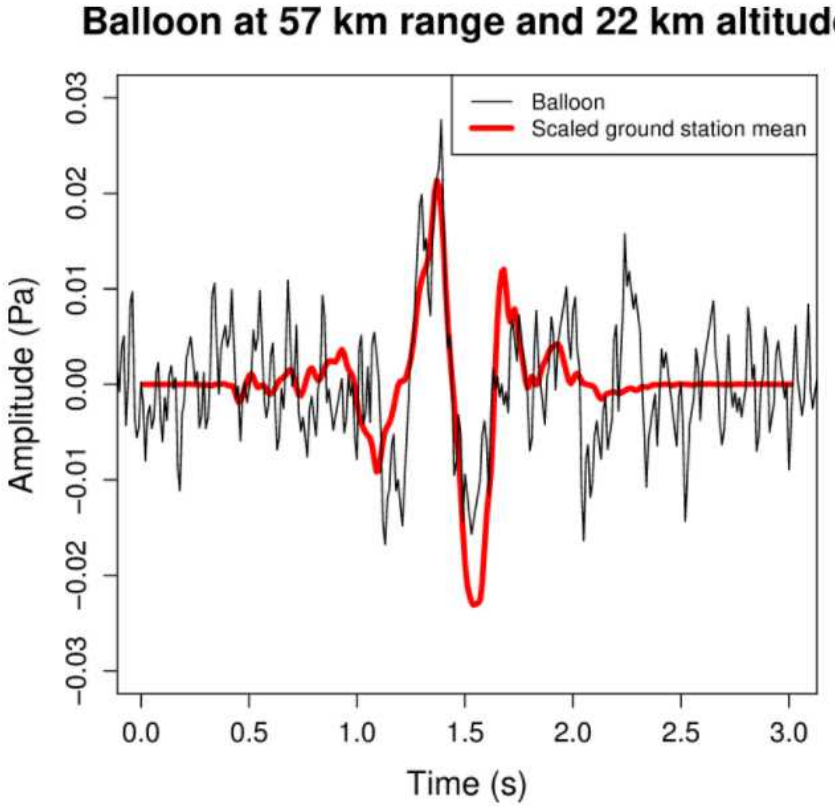
Background noise: IMS vs. balloon



Objective

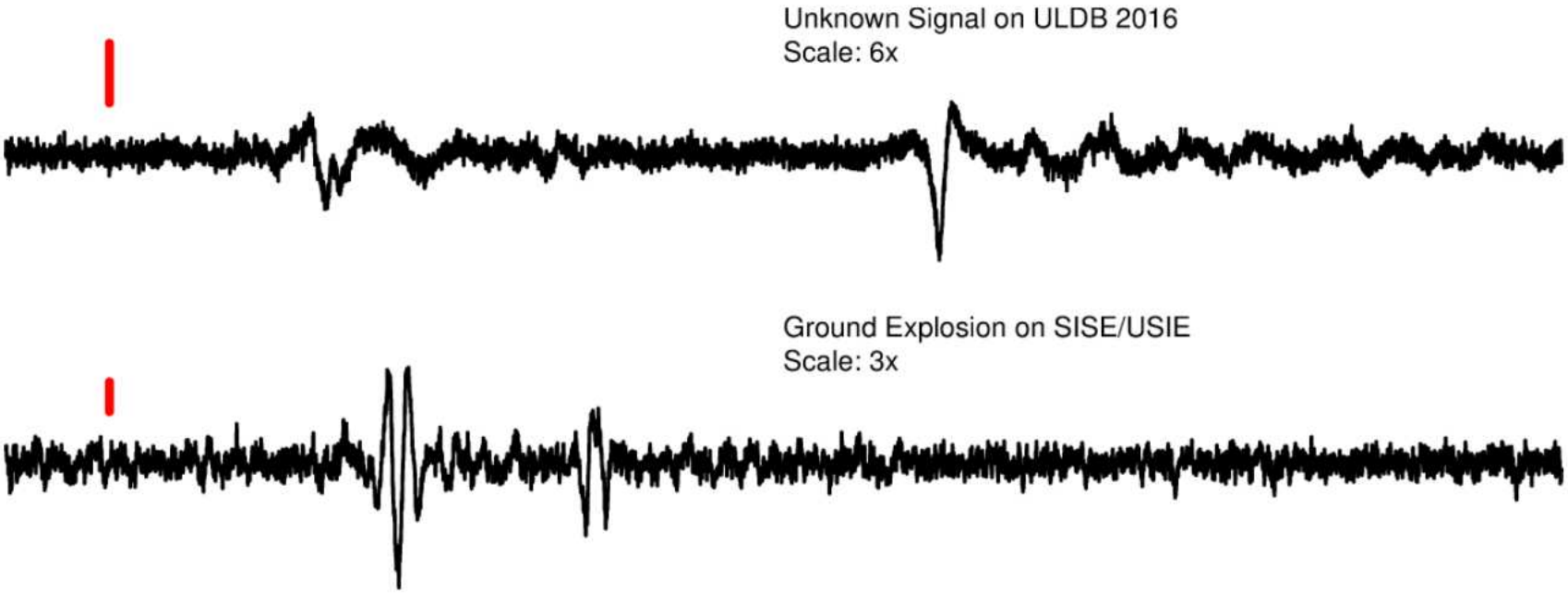
Explore a new domain in acoustics

Strategy 1: Deploy against existing experiments



The Source Physics Experiment/Dry Alluvium Geology campaign was a series of buried chemical explosions at the Nevada National Security Site. We fielded 5 infrasound balloon payloads during the series.

Strategy 2: Piggyback on long flights



Long duration flights allow for background noise assessment and the possibility of rare events (microbarom overflight, bolide airburst, strong thunderstorms).

Strategy 3

Collaborate with external partners

- Jet Propulsion Laboratory
- Southwest Research Institute
- NASA Ames
- Guide Star, Inc.

Strategy 4

Strategy 4: R & D with local assets

- Sandia's Facility for Acceptance, Calibration and Testing (FACT) site
- The Energetic Materials Research and Testing Center (EMRTC)
- The Heliotrope balloon

The FACT site

Purpose: Evaluate geophysical sensors

Calibrate infrasound payloads against known standards
Some ability to decrease chamber pressure

EMRTC

The New Mexico Institute of Mining and Technology's Energetic Materials Research and Testing Center (EMRTC) enables us to make very powerful acoustic sources

- SISE/USIE (2016)
- Heliotrope (2017)
- JPL buried explosion experiments (2019)
- SNL SUPERSEIS experiment (2019)
- NASA Flight Opportunities Program (summer 2020)
- More..?

The Heliotrope balloon

A solar powered hot air balloon capable of delivering small scientific payloads to the lower stratosphere for multi hour float times.

Motivation

Long duration balloon flights are challenging

- Weather balloons
- Tandem balloons
- Zero pressure/superpressure balloons
- **Solar powered hot air balloons**

A DIY solar balloon

Deliver 0.5-1.5 kg to 15-24 km

Flies all day

Launch from anywhere

Costs $50

Two people build in 3.5 hours

Requires calm, clear weather

Design

HDPE plastic envelope

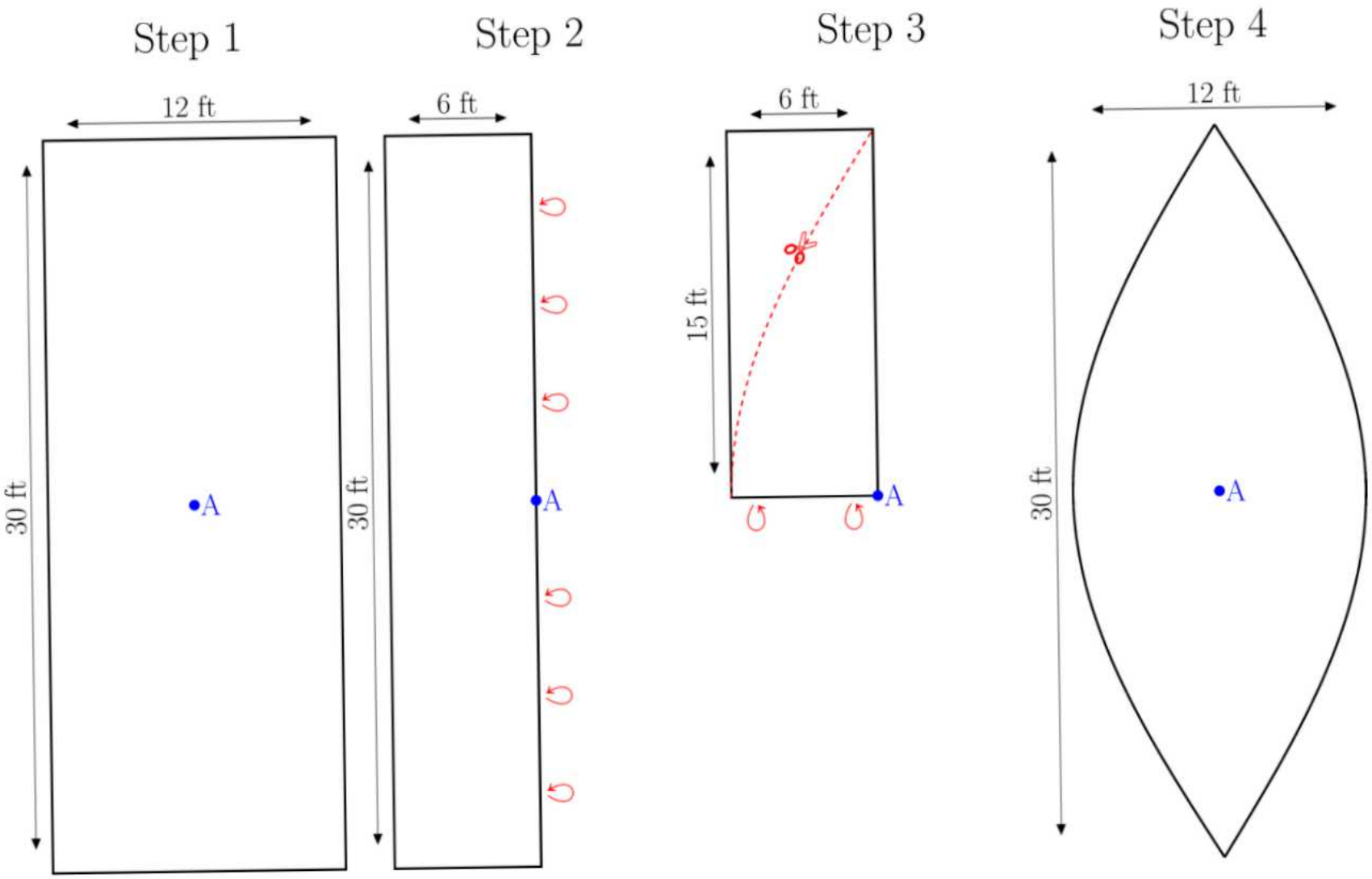
Spherical gore pattern

Shipping tape on seams

Charcoal powder darkener

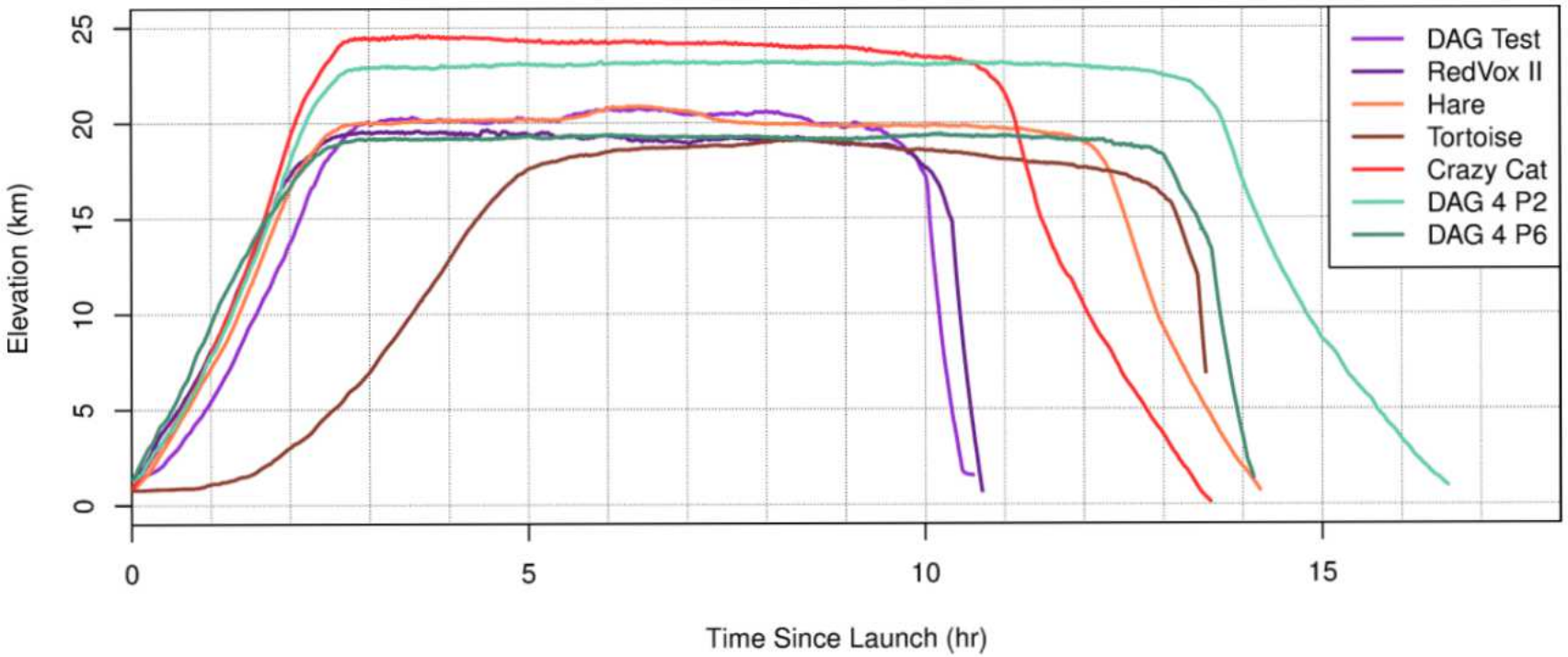
Bottom left open

Gore cutting



Launch

Trajectories



A combination of Sandia and JPL flights

Conclusions

Sandia has a robust high altitude infrasound R & D program

Initiative benefits from in-house development and collaborations

Unique capabilities (e. g. FACT, Heliotrope) assist this effort

Acknowledgments

Sandia National Laboratories is a multimission laboratory managed and operated by National Technology and Engineering Solutions of Sandia, LLC., a wholly owned subsidiary of Honeywell International, Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525.