AEROSPACE

Measuring Falcon-9 Rocket Sonic Booms to Understand Launch Noise



CUSTOMER
The Aerospace Corporation

PRODUCT
GRAS 46AE
GRAS 47AC

JASA Express Letters >

The Customer

The Aerospace Corporation is a leading nonprofit organization that provides technical expertise and independent engineering support to U.S. national security space programs. The organization conducts advanced research in areas such as launch systems, space operations, and aerospace acoustics, supporting government agencies and industry partners.

Through its research programs, The Aerospace Corporation studies the environmental and acoustic impact of rocket launches, helping improve predictive models and support the safe expansion of commercial and government space launch operations.

The Challenge

As the number of rocket launches increases globally, understanding the acoustic impact of rocket ascent sonic booms on surrounding communities and infrastructure has become increasingly important. Sonic booms generated by rocket launches can travel long distances and may be heard many miles from the launch site depending on trajectory, weather conditions, and atmospheric propagation.

Researchers studying the Falcon-9 rocket launches from Vandenberg Space Force Base in California conducted a measurement campaign in Ventura County, located roughly 60–100 miles (100–160 km) from the launch site, where sonic booms are sometimes detected on land.

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The challenge was to capture accurate acoustic measurements of low-frequency sonic boom signatures over a large geographic area while accounting for environmental variability such as atmospheric conditions, trajectory differences, and background noise.

The Solution

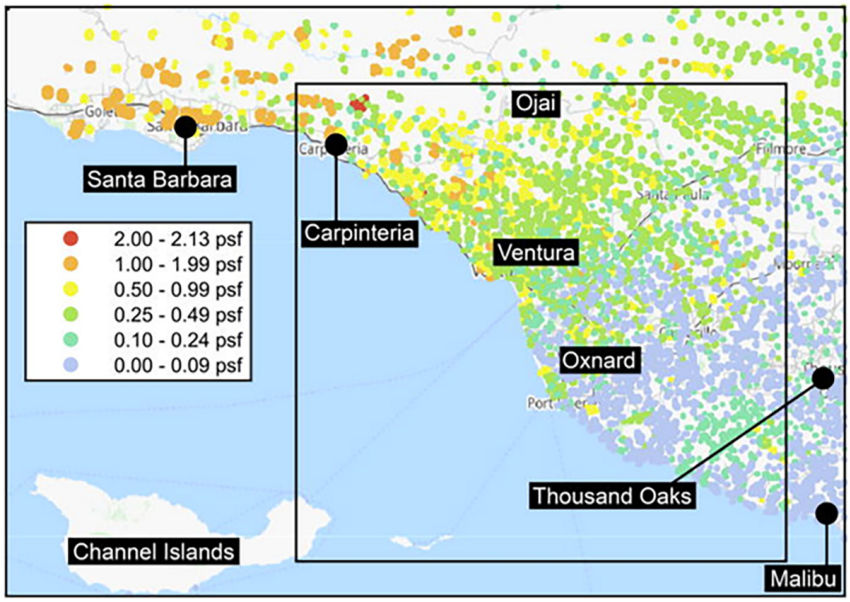
To better understand rocket ascent sonic booms, researchers deployed a distributed acoustic measurement network across approximately 200 square miles in Ventura County. The campaign collected over 130 sonic boom measurements during multiple Falcon-9 launches.

High-performance measurement microphones were used to record the pressure waveforms and acoustic signatures generated by the rocket as it accelerated through the atmosphere.

These measurements enabled researchers to:

- Capture the waveform and overpressure characteristics of Falcon-9 ascent sonic booms
- Study how meteorological conditions and launch trajectory influence acoustic propagation
- Map the geographic distribution of sonic boom levels across the region
- Improve models predicting rocket-generated sonic boom impacts

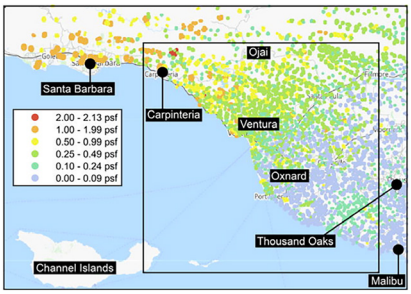
Because rocket ascent booms contain very low-frequency energy—often below the range of human hearing—they can cause buildings to vibrate or rattle rather than producing a traditional audible boom.



The Results

The collected data contributes to ongoing research aimed at enabling the sustainable growth of the space launch industry while minimizing environmental and community impacts.

Read more about the result on the next page.



The Results

The measurement campaign produced valuable data that improves understanding of rocket launch acoustics and community noise exposure.

Key outcomes included:

- Detailed mapping of peak overpressure levels across Ventura County
- Improved understanding of how weather and trajectory affect sonic boom propagation
- Validation data to refine rocket noise prediction models
- Insights supporting future space launch operations and policy decisions

The collected data contributes to ongoing research aimed at enabling the sustainable growth of the space launch industry while minimizing environmental and community impacts.

GRAS Products Used

For the acoustic measurements, the research team used high-precision measurement microphones from GRAS Sound & Vibration.

The setup included: GRAS 46AE and **GRAS 47AC**

GRAS 46AE
1/2" CCP Free-field Standard Microphone Set

Freq range: 3.15 Hz to 20 kHz
Dyn range: 17 dB(A) to 138 dB
Sensitivity: 50 mV/Pa

GRAS 46AE >



GRAS 47AC
1/2" CCP Infra-Sound Microphone Set

Freq range: 0.09 Hz to 20 kHz
Dyn range: 20 dB(A) to 148 dB
Sensitivity: 8 mV/Pa

GRAS 47AC >



These microphones are designed for demanding acoustic measurements where accuracy, wide dynamic range, and low noise are critical. Their performance enabled reliable capture of the sonic boom signals during the Falcon 9 ascent measurements.

Why Precision Acoustic Measurements Matter

Rocket ascent sonic booms present unique measurement challenges, including extremely low-frequency signals, long propagation distances, and environmental variability.

High-precision measurement microphones with low noise, wide dynamic range, and stable calibration are essential for capturing these complex acoustic events accurately.

Measurement-grade acoustic sensors enable researchers and aerospace engineers to analyze launch acoustics, improve predictive models, and support the design of quieter and more sustainable launch operations.

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ABOUT GRAS
– Precision Acoustics for Space Applications

GRAS Sound & Vibration develops high-precision microphones and acoustic measurement systems used in demanding environments where accuracy, stability, and reliability are critical. For space and launch vehicle testing, GRAS microphones are trusted by research institutions and aerospace organizations to capture extreme acoustic events such as rocket launches, sonic booms, and high-intensity pressure waves.

GRAS solutions are designed to deliver low noise, high dynamic range, and robust performance in harsh environments, making them well suited for aerospace and space research applications where precise acoustic data is essential for analysis and validation.

For more information,
please contact marketing@grasacoustics.com.

ABOUT GRAS SOUND & VIBRATION

GRAS is a worldwide leader in the sound and vibration industry. We develop and manufacture state-of-the-art measurement microphones to industries where acoustic measuring accuracy and repeatability is of the utmost importance in R&D, QA and production. This includes applications and solutions for customers within the fields of aerospace, automotive, audiology, and consumer electronics. GRAS microphones are designed to live up to the high quality, durability and accuracy that our customers have come to expect and trust.
GRAS Sound & Vibration is represented through subsidiaries and distributors in more than 40 countries and is part of Axiometrix Solutions, a leading test solutions provider comprised of globally recognized measurement brands.