

Scope and goals of the NASA Quesst Community Test Campaign with the X-59 aircraft



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In a couple years, NASA is slated to begin a nationwide socio-acoustic survey to understand how people respond to low noise supersonic overflights.

NASA will use this one-of-a-kind X-59 experimental aircraft, but the results will generalize to any future supersonic aircraft.

On behalf of my coauthors, I am pleased to share with you about the scope and goals of this community test campaign.

NASA wants to improve aviation by decreasing travel time.



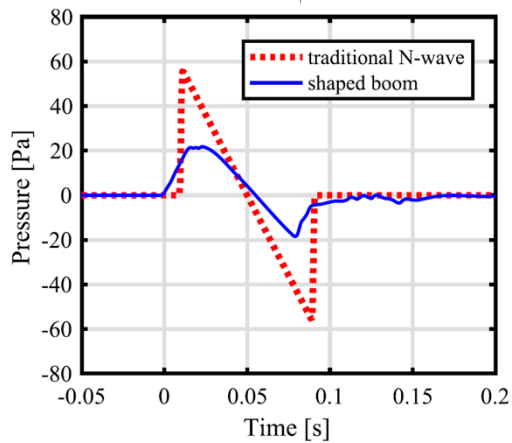
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This ICBEN conference here in Belgrade has participants from multiple continents.

How different would travel here be if flight times here took half as long or less?

Civilian supersonic flight banned in 1973 because of loud sonic booms.

Aircraft shape is the key to reducing sonic boom noise levels.



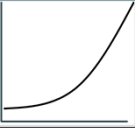
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Aircraft shaping techniques to reduce sonic booms will be demonstrated by the X-59 for the first time in a clean-sheet, piloted aircraft.

X-59 is designed to produce a waveform that is typical of future airliners.

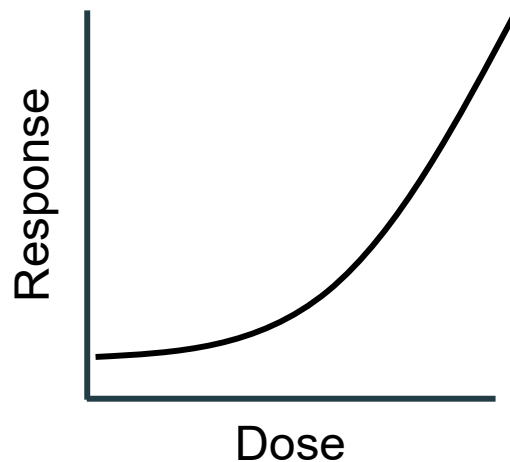
The red signal is 105 dB (nearby thunder or car door slam inside the car) and the blue signal is 75 dB (distant thunder, car door slam across the street).

NASA data will support new noise standards for supersonic aircraft.

	Research goals
	Scope of data collection
	Potential challenges



The primary research goal is representative dose-response data.



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Socio-acoustic surveys generally target a dose-response relationship. That's what NASA aims to produce.

For single overflight, the dose metric will be one of six candidate metrics like Perceived Level or another sound exposure level. The response metric is the 5-point verbal scale, subject to a cutoff so the top two categories represent high annoyance.

What about the effects of repeated exposures? A cumulative exposure dose-response relationship will show the effects of repeated exposure, where the dose metric will be a cumulative equivalent of PL or SEL, and the response metric will also be the 5-point verbal scale.

The secondary research goals are to collect data that help interpret dose-response results.



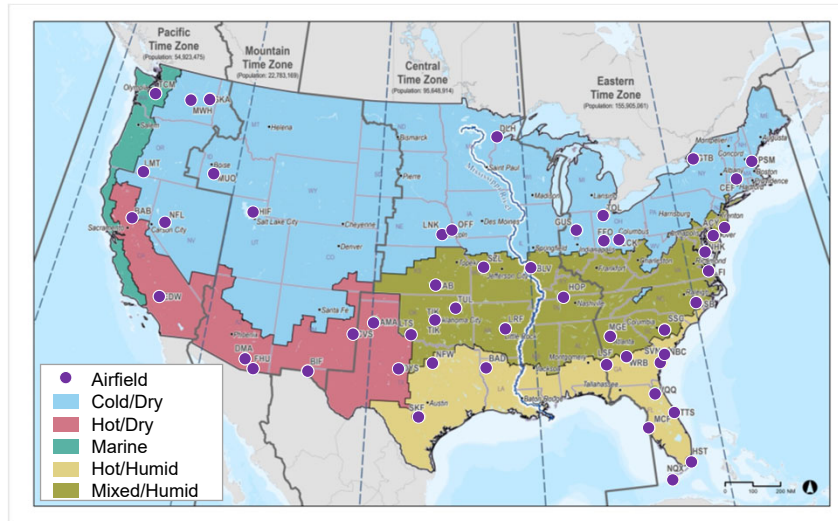
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Secondary research goals are to collect data to help interpret dose-response results. These data will be gathered via survey questions.

- effects of indoor rattle and vibration
- effects of listening environment
- effects of time-of-day
- prevalence of “startle” which was a major annoyance component in historic sonic boom studies

The survey will be web-based, accessible via computer, mobile device, or via smart phone app.

NASA plans up to five social surveys in different geographic regions of the US.



To collect representative data, NASA is planning up to five 1-month-long socio-acoustic surveys. To be representative, the test locations must span the various US geographic regions.

This chart shows approximately 4 dozen airfields that meet the X-59 operational requirements overlaid on the major US climate zones. From each airfield, a 600 sq n mi survey recruitment region will be selected to be overflowed up to six times daily for a month. The month-long duration was chosen to give participants time to adjust to the new sounds.

The first test will be flown from NASA Armstrong / Edwards Air Force Base in southern California over a region to be determined. The subsequent airfields and recruitment regions have not yet been selected.

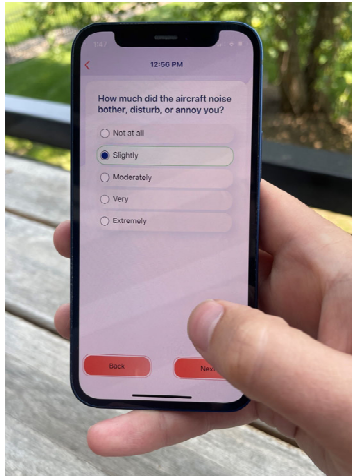
NASA will design the X-59 noise exposure schedule to best support dose-response analysis.



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The Quesst mission differs from a typical socio-acoustic survey. It is more experimental than just observational because the X-59 noise exposure is variable. The range of single event sounds and cumulative sounds is just under 20 dB for single events and for cumulative exposure using the PL and PLDNL metrics. The noise exposure will be estimated via a combination of measurements (as shown here) and calculations.

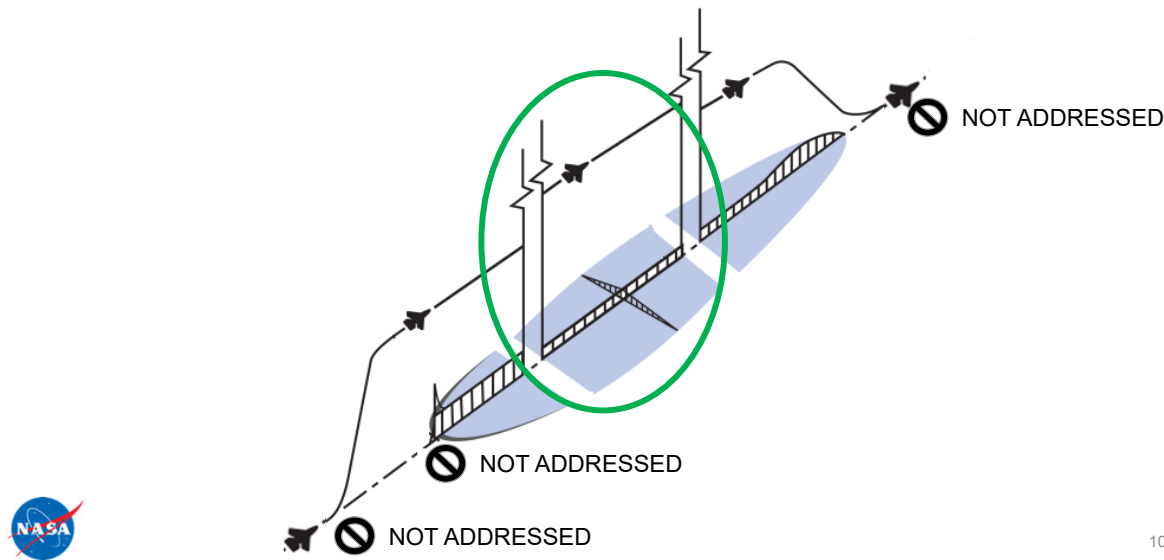
A minimum sample size of 1000 participants per region is currently planned.



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In each region, NASA intends to recruit a probability-based sample of 1000 participants. This sample size was selected to improve the stability of dose-response estimates based on survey data from a previous test. It will also enable representativeness in terms of diversity of age and socioeconomic status, although neither is expected to have a strong influence on the dose-response relationship. A test of the survey process without X-59 overflights is planned for later this year.

The Quesst mission focuses on *human response to supersonic cruise* during *daylight hours*.



The need to focus test objectives means that certain data will not be collected.

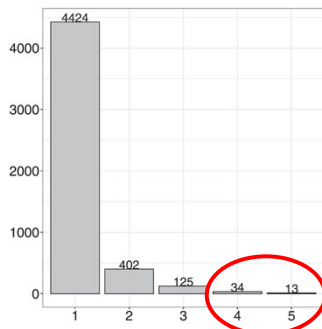
The effect of low noise supersonic overflights on animals will not be tested because adverse effects are not expected.

The mission focuses on supersonic cruise, not landing and takeoff noise, nor focus boom noise, although the dose-response relationship for supersonic cruise also applies to focus booms in that noise dose range.

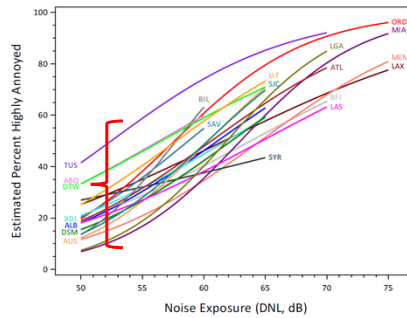
Nighttime noise exposure cannot be tested in the current timeframe due to operational and safety considerations.

While sonic booms are not the only barrier to viable commercial supersonic flight over land, they are the key barrier. Other barriers to supersonic flights to be addressed beyond the Quesst mission include high altitude emissions and aircraft efficiency. NASA has active research programs in both areas.

Several key potential challenges may need to be mitigated to produce a representative dose-response relationship.



Sparse observations of high annoyance



High variability between regions (Neighborhood Environmental Survey by US FAA)



Survey bias

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Sparse observations of high annoyance. Less than 1% highly annoyed in recent testing. Challenges traditional dose-response modeling techniques. Mitigations are to fly some missions at even higher noise doses to produce more observations of high annoyance.

High variability between regions, which could complicate efforts to establish a single, representative dose-response relationship from up to six test sites.

The possibility of unintentionally influencing survey results in the process of informing the public about X-59 overflights. NASA's mitigation is to keep communications as informative and objective as possible. NASA has assembled an expert panel to review and ensure objectivity in communications materials.

Global consensus on overall technical approach is key to acceptance of Quesst data.



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One key to international acceptance of the data is global consensus on the overall technical approach.

NASA welcomes the opportunity to partner with other organizations to conduct X-59 overflights and a community survey outside the US.

NASA welcomes the possibility of collaborating with other research and regulatory organizations during the US community tests to address additional research areas or questions.

In summary, NASA will collect representative socio-acoustic data to support new standards for low noise supersonic overflights.



The goal of commercial supersonic flight is decreased travel time.

Dose-response relationships for annoyance data are the focus.

Global consensus on technical approach is key.

Questions?

