

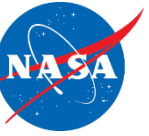
An Overview of the NASA Quesst Community Test Campaign with the X-59 Aircraft



DATAWorks 2023
Alexandria, VA
April 26, 2023

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Outline



- 1) NASA's Quesst Mission**
- 2) Phase 3 – Community Response Testing**
- 3) Challenges and Strategies**

NASA Quesst Mission



Community Test Campaign

Engage
international
research and
regulatory
communities

Prove NASA
shaping
technology
quiets sonic
booms

Gather
representative
data on public
perceptions

Develop
standards for low
noise supersonic
flight over land

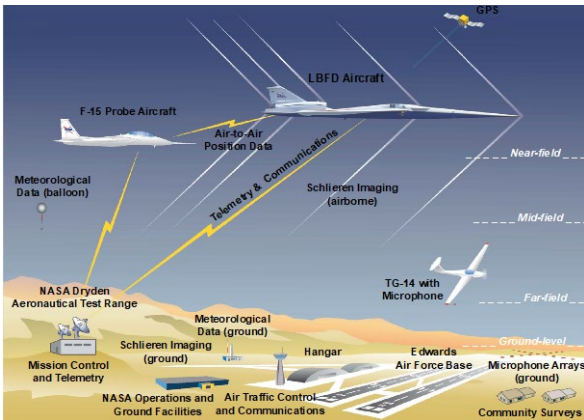
Phases of the NASA Quesst Mission



Phase 1 – Aircraft Development

In progress (2018-2024)

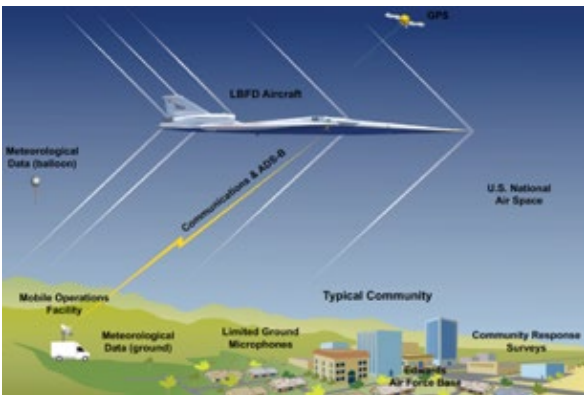
- Detailed design
- Fabrication, integration, ground test
- Subsonic and supersonic envelope expansion



Phase 2 – Acoustic Validation

Preparation in progress, execution begins 2024

- Detailed in-flight and ground measurements
- Validation of X-59 acoustic signature and prediction tools
- Development of acoustic prediction tools for Phase 3



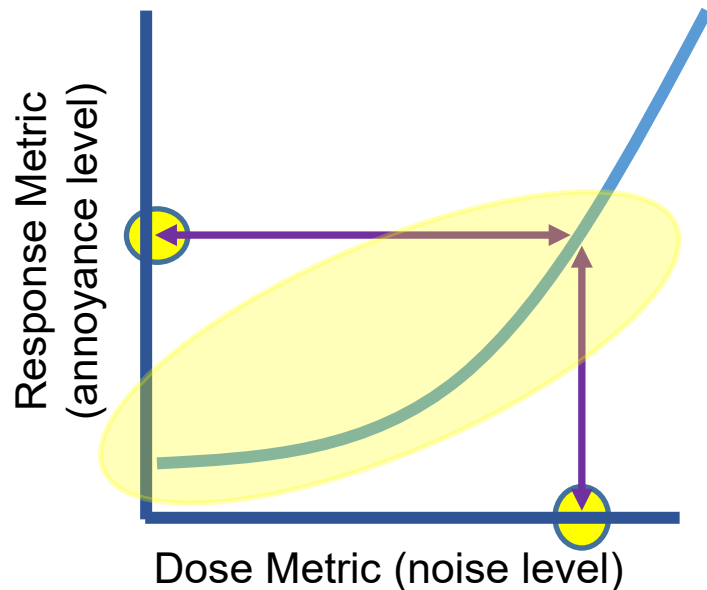
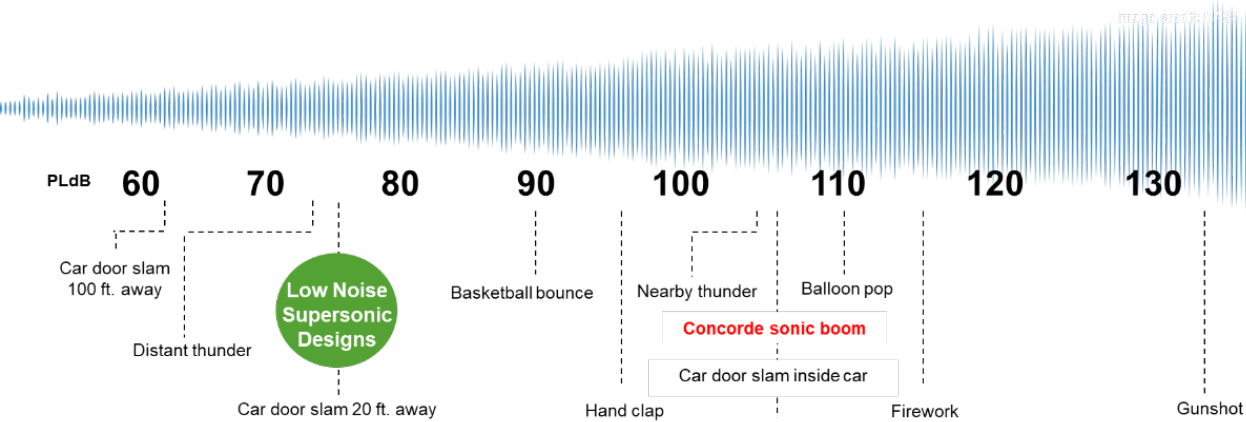
Phase 3 – Community Response Testing

Preparation in progress, execution begins 2025

- Community site selection
- Community response surveys
- Noise exposure design and estimation (measurement and predictions)
- Dose-response relationship development and data delivery

**Systematic
Approach Leading
to Community
Testing**

Quesst Phase 3 - Community Response Testing



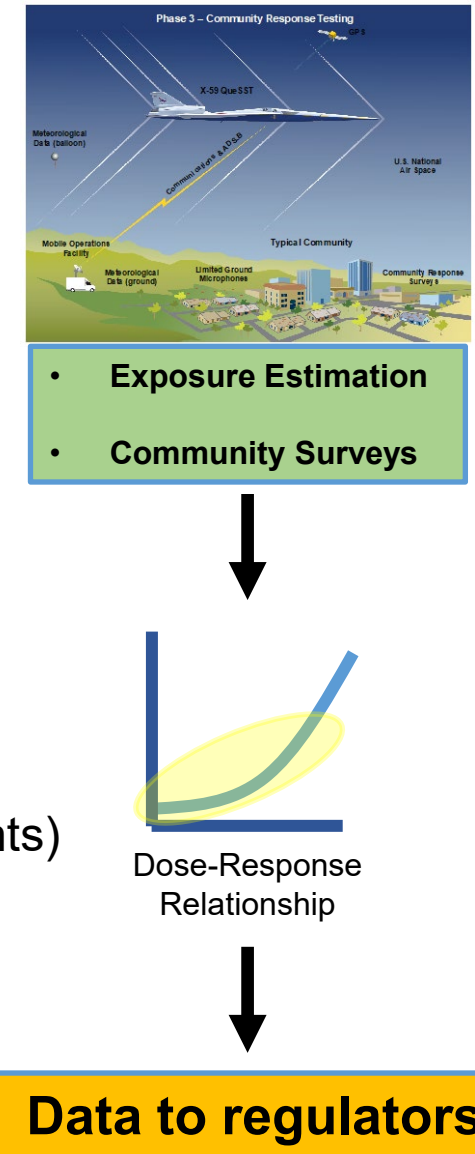
Some aspects of community tests

- 4-6 tests in different communities across the US
- Location selection will consider:
 - Variation in climate zones
 - Population demographics
 - Urbanization level
- Each test approximately 1 month long
- Daytime/waking hours
- Range of sound levels: 70 to 87 dB
- Acquire community response representative of the general population

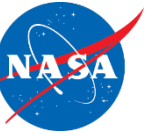
Key Technical Elements of Community Response Testing



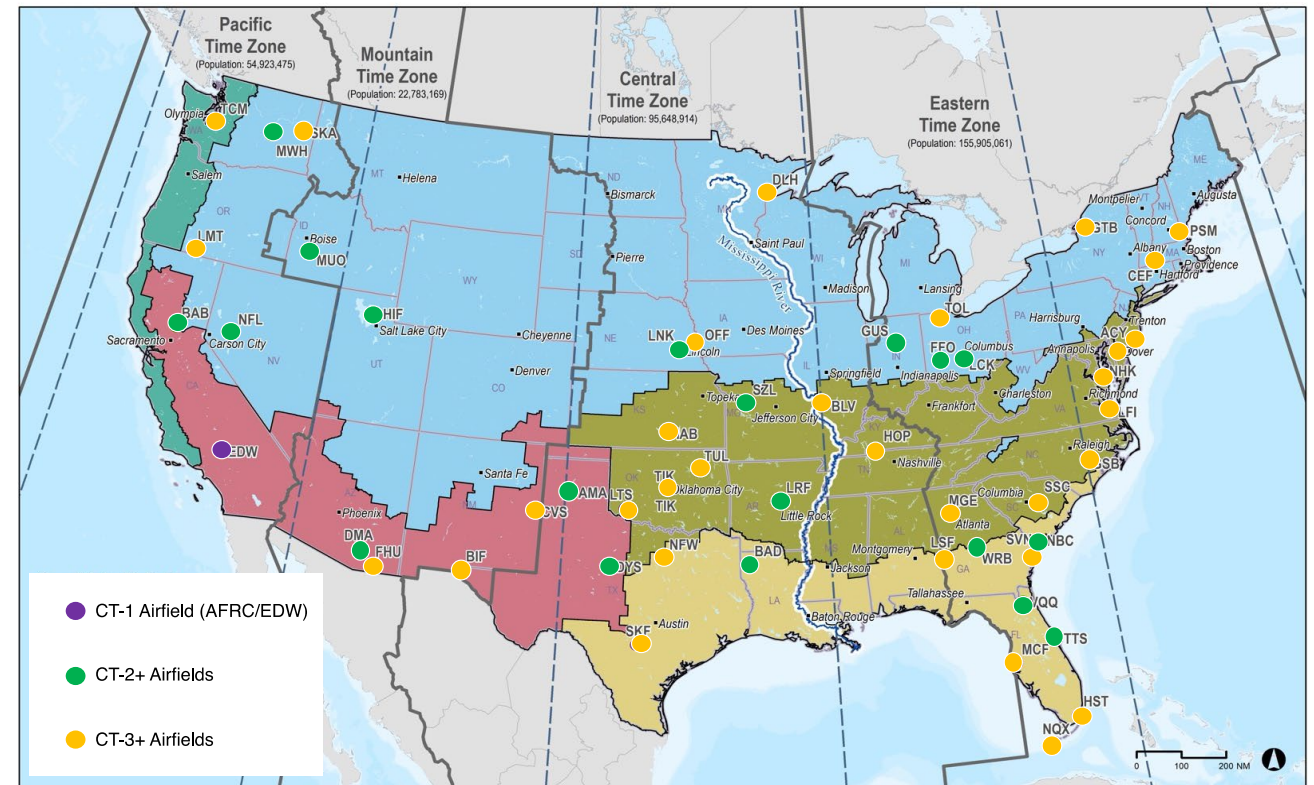
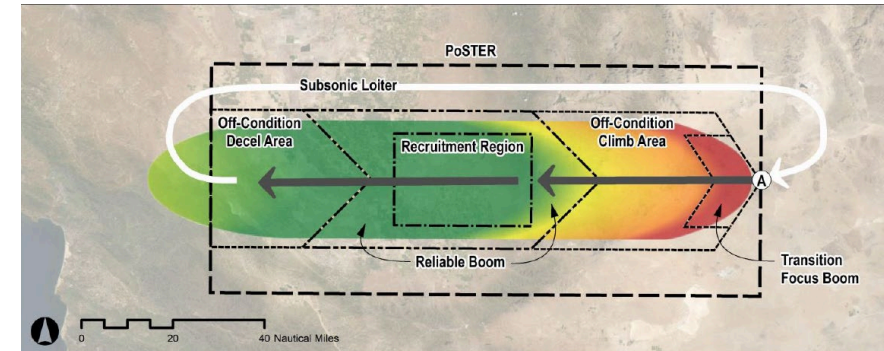
- Test site selection
 - Ensure representativeness
 - Deployment coordination/logistics
 - Public engagement
- Survey Design and Analysis
 - Participant recruitment
 - Data analysis/statistical methods
 - Tests of survey implementation, automated data processing methods
- Exposure Design and Estimation
 - Ground Recording System (acoustic monitor) placement strategies
 - Recording and extraction of signature
 - Characterization of carpet over test area (combining prediction and measurements)
- Developing Dose-Response Relationship and Delivery to ICAO
 - Matching exposure levels with participant location
 - Aggregating of multiple community test results
 - Ensuring validity/acceptance of technical approach



Airfield and Community Test Site Selection



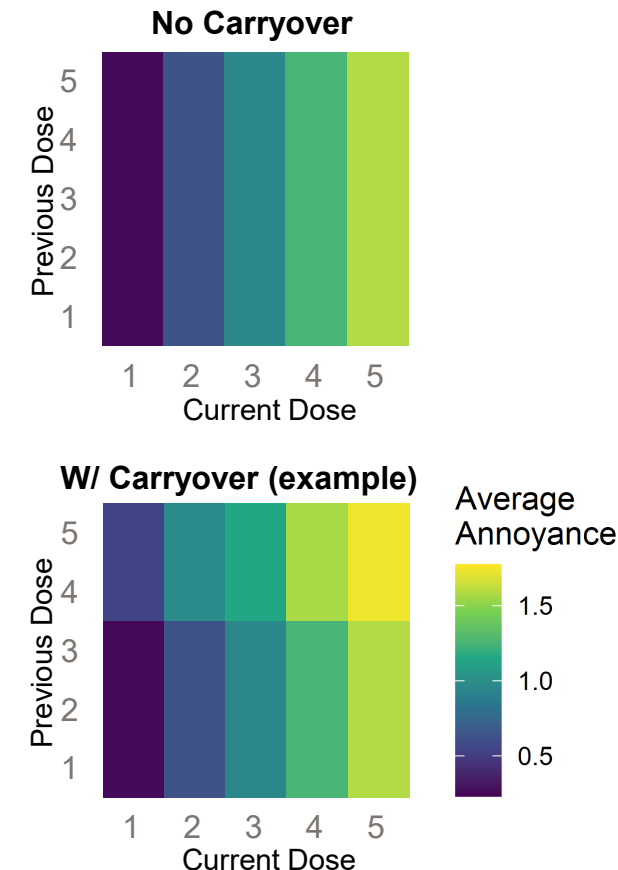
- **4-6 Tests planned for 2025-2027**
 - Test #1 from NASA Armstrong
 - Subsequent test locations TBD
- **Technical and aircraft-related constraints**
 - Runway, airfield infrastructure
 - Emergency/alternate landing sites
 - Available population centers
- **Ensuring representativeness**
 - Sampling approaches and statistical validity
 - Geographic and climate zone variation
 - Survey participant demographic diversity
 - Variation in urbanization level



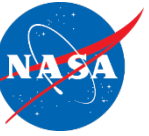
Survey Design and Analysis



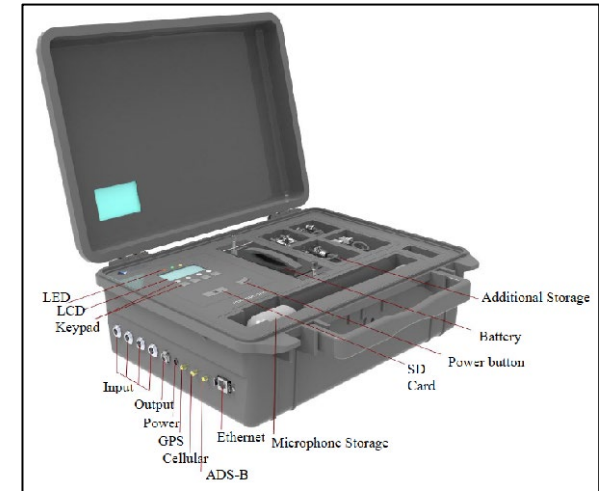
- **Development of dose-response simulation dataset**
- **Survey methods and analysis plans developed**
 - Proposed methods are generally robust with high likelihood of success
 - Addressing / Refining challenge areas
 - Sparse data / data sufficiency
 - Dose error mitigation
 - Combining data from multiple communities
- **Research on effect of dose error on dose-response curve**
 - Dose error creates a bias in dose-response curve
 - Bias not alleviated by increasing number of survey participants
 - Accuracy requires emphasis on quantifying, minimizing, and mitigating error
- **Study of potential for carryover effects in survey results**
- **Feedback from Independent Expert Panel on survey plans**



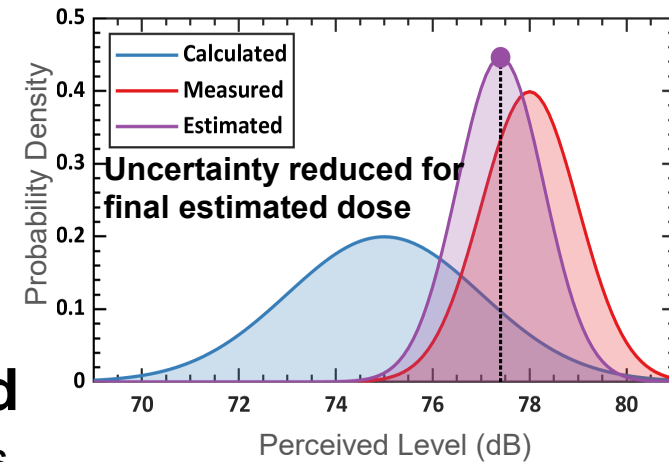
Noise Exposure Design, Estimation, and Analysis



- **Estimation and refinement of attainable range of boom levels**
- **Noise Exposure Scheduling Tool Developed**
 - Automated, adaptable dose scheduling for Phase 3
 - Inputs for dose range, operational constraints (X-59, crew rest, etc.)
- **Meteorological data needs identified**
 - Hardware selection with data-based assessment of resolution
 - Validation cases finalized for regional forecast model
 - Method to extract turbulence parameters from atmospheric models
- **Progress of Ground Recording System towards Phase 3 use**
 - Prototype units evaluated
 - Initial operations procedures for community test usage developed
- **Key components of dose and uncertainty calculation assembled**
 - Algorithms to identify measured boom, mitigate ambient noise, compute metrics
 - Combine measurements with calculated doses at participant locations



Ground Recording System Unit



Combining calculated and measured levels
(Notional Example)

International Engagement / Feedback

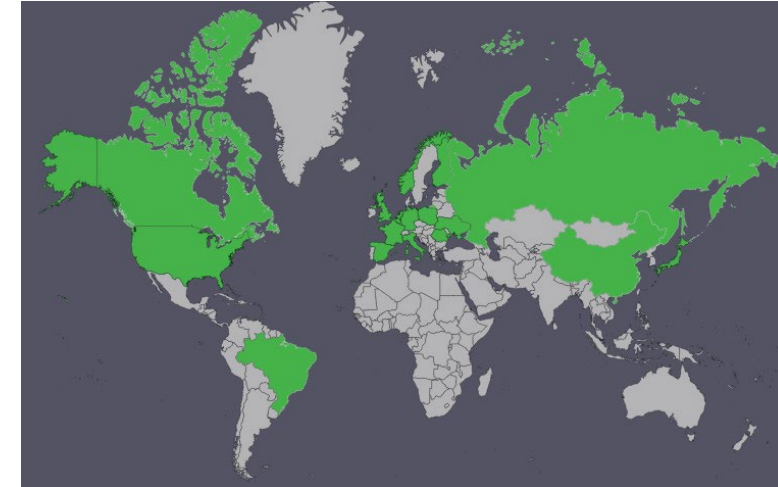


- **International Community Test Workshop 2 – December 2021**

- First major dissemination of scope of NASA plans
- General concurrence from attendees with overall technical approach
- Concerns expressed and discussed during workshop included:
 - Applicability of dataset; methods to expand representativeness
 - Characterization of annoyance relationship to rattle/vibration
- NASA is incorporating inputs to survey and exposure design/analysis plans as appropriate
- Ongoing follow-up/engagement with key SME's

- **Additional international engagement**

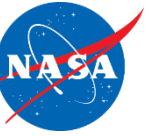
- Aug 2022, Internoise Conference, Glasgow
- June 2023, ICBEN Congress on Noise as a Public Health Problem, Belgrade
- Aug 2023, Internoise Conference, Chiba, Greater Tokyo
- Ongoing, International Civil Aviation Organization, Committee on Aviation Environmental Protection, Working Group 1 (Noise)



Broad International Participation

- 18 Countries
 - 120+ attendees
 - 50+ organizations
- | | |
|--------------|------------------------|
| - Research | - Academia |
| - Regulatory | - Industry – technical |
| - Government | - Industry - OEM |

Organizational Challenges



Challenge

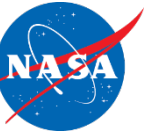
- **Long Time Span**
- **Many resources to manage**
- **Contractor Teams**
 - Ground Recording System
 - Community Response Testing Support (7 companies)
- **Diverse Stakeholders**
 - Multiple NASA Centers
 - International Civil Aviation Organization and Federal Aviation Administration
 - Federal, state, and local government
 - The public

Strategy

- **Communication**
- **Active stakeholder engagement**



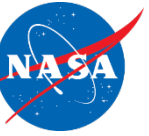
Summary



- NASA's Quesst Mission will provide key community response data
 - NASA seeks broad international engagement to ensure acceptance of the test results
- Key technical areas include site selection; survey design and analysis; noise exposure design, estimation, and analysis; and dose-response modeling
- Organizational challenges and strategies for managing a project of this scope



Questions?



QUEST

<https://www.nasa.gov/quest>

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