



NASA's Quesst Mission – Preparations for Community Response Studies



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NASA Langley Research Center

AIAA SciTech 2025

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Overall Quesst Timeline

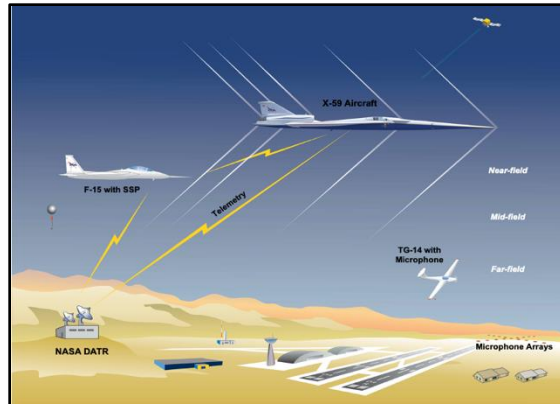


Phase 1 – X-59 Aircraft Development

Aircraft design, fabrication, ground test, checkout and envelope expansion

**First Flight
2025**

Credit: Lockheed Martin



2026

Phase 2 – Acoustic Validation

Detailed ground and flight measurements
Validation of sonic boom signature and prediction tools



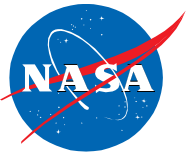
2027

Credit: Lockheed Martin

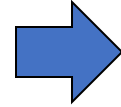
Phase 3 – Community Response

Community response overflights,
ground measurements, and
surveys over representative
communities across the U.S.

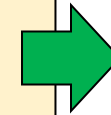
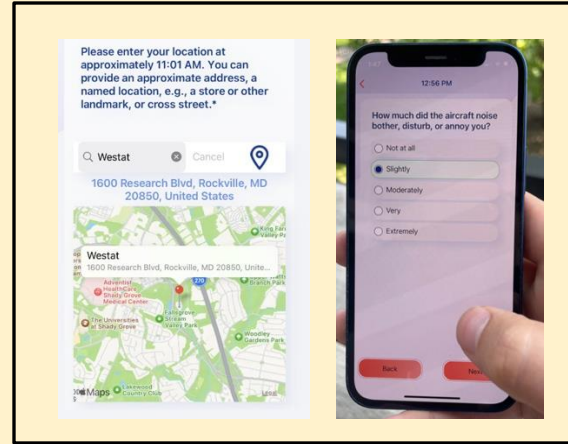
Phase 3 Stages: Planning → Execution → Data Delivery



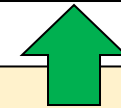
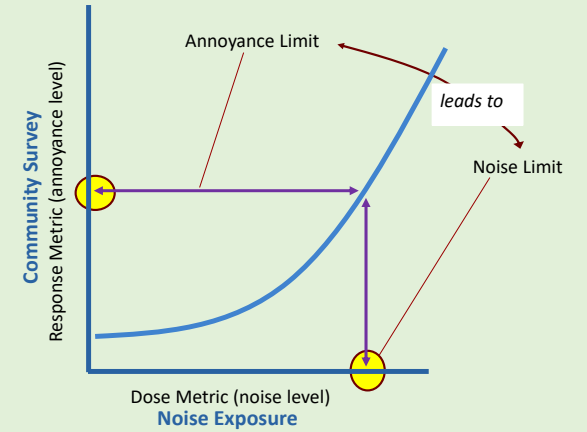
Airfield and Community Selection



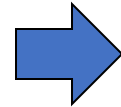
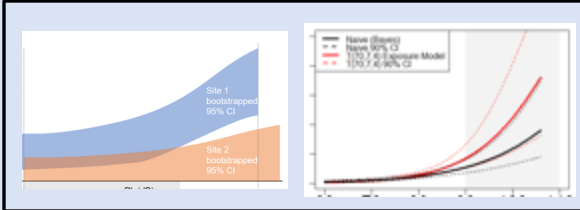
Public Survey Response



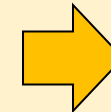
Dose-Response Relationship



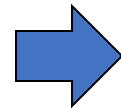
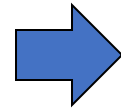
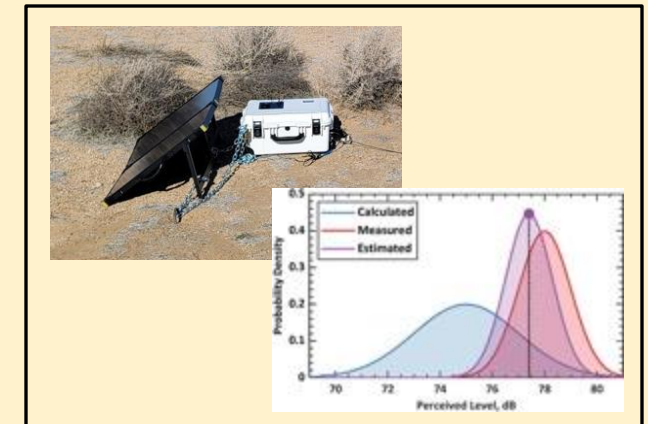
Survey Design and Analysis



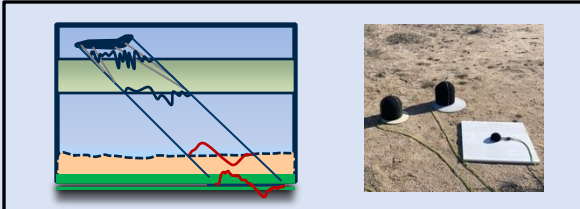
X-59 Community Overflights



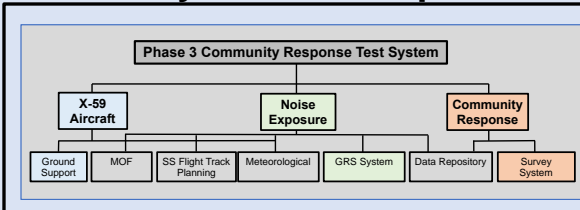
Acoustic Levels



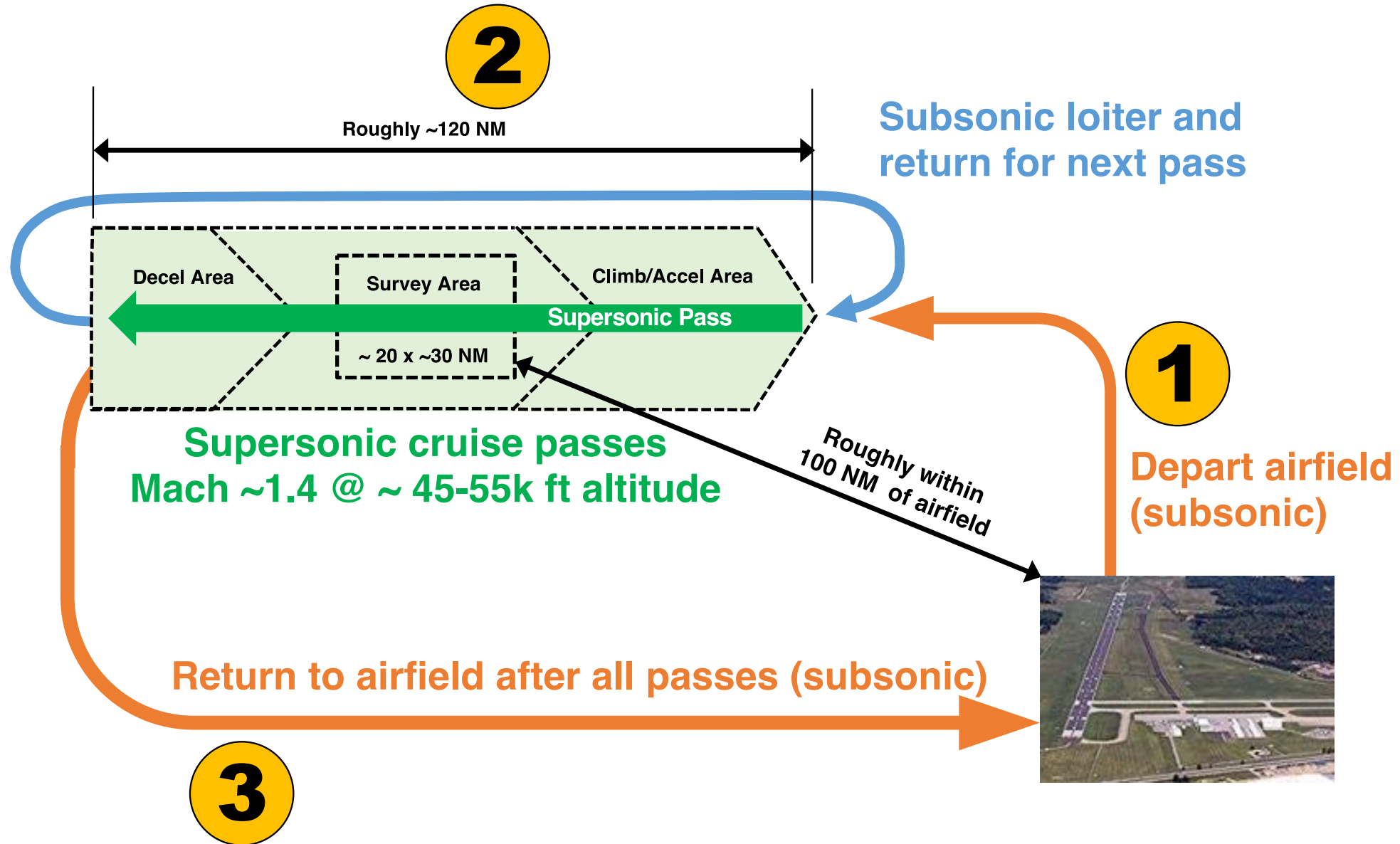
Exposure Estimation



Data System Development

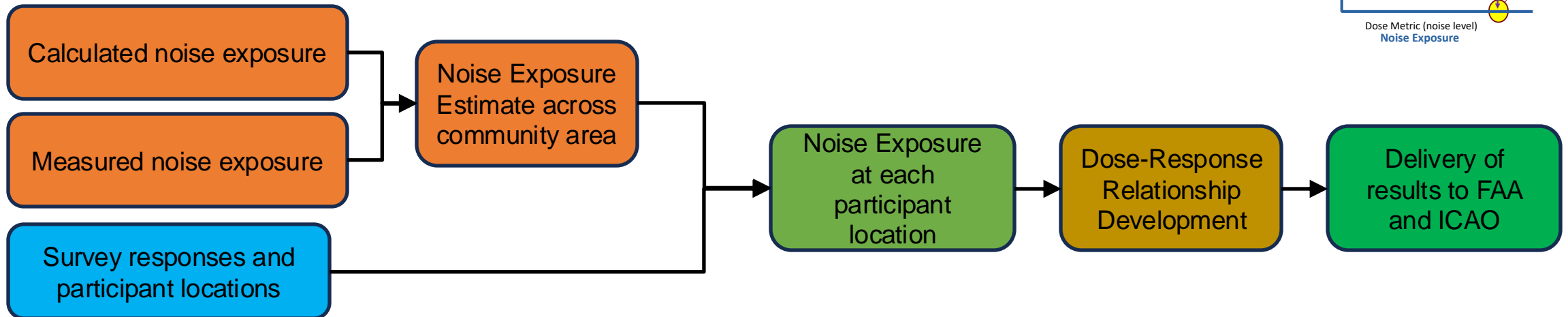
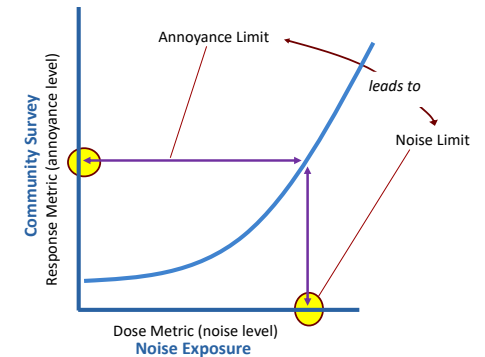
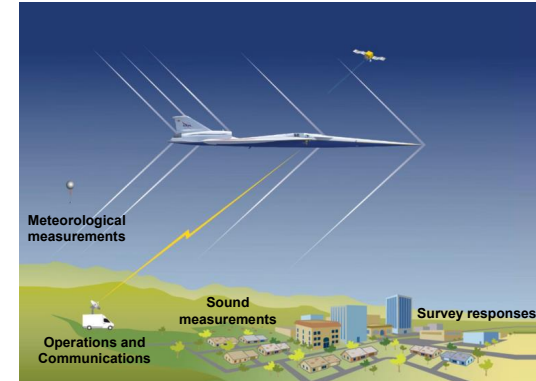


Notional/Typical Community Response Flight

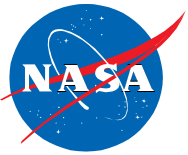


Data Collection, Processing, and Delivery

- Calculated noise exposure via propagation analysis for as-flown conditions
- Measured noise exposure – Acoustic waveforms and metrics via GRS
- Single-event and cumulative survey responses and participant locations
- Measured and calculated levels combined for best estimate of exposure
- Resulting exposure levels matched to participant response and location
- Dose-response analyses
 - Individual Community Tests
 - Combining across multiple tests
- Delivery of technical methods and overall results to FAA and ICAO



Quesst Phase 3 – Contractor Team



- **Support contract to aid in all elements of planning and execution of community tests**
- **Build-out of joint government and industry team**
 - Multiple specialized subcontractors
 - SME from US DOT Volpe Center
- **Contractor Team roles**
 - Survey methods and analysis plans
 - Exposure scheduling and estimation
 - Statistical data analysis; development of dose-response relationship
 - Deployment support (Exposure planning, survey, instrumentation, data processing)
- **NASA roles**
 - Oversight and SME guidance to contractor team
 - Technical review/approval of all planning and execution aspects
 - Complementary SME research related to Phase 3 community testing
 - Identify, address, and mitigate technical gaps as needed
 - Direction and execution of community tests (aircraft and ground operations, community engagement)

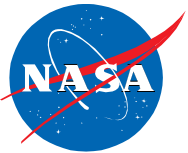
Prime Contractor



Harris Miller Miller & Hanson Inc.
Burlington MA

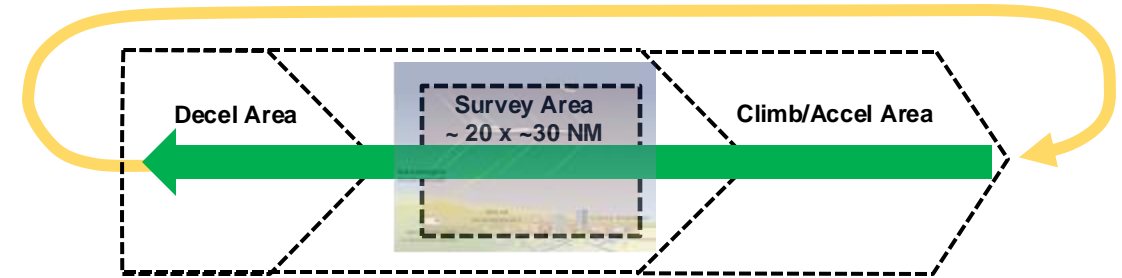


Airfield and Community Selection



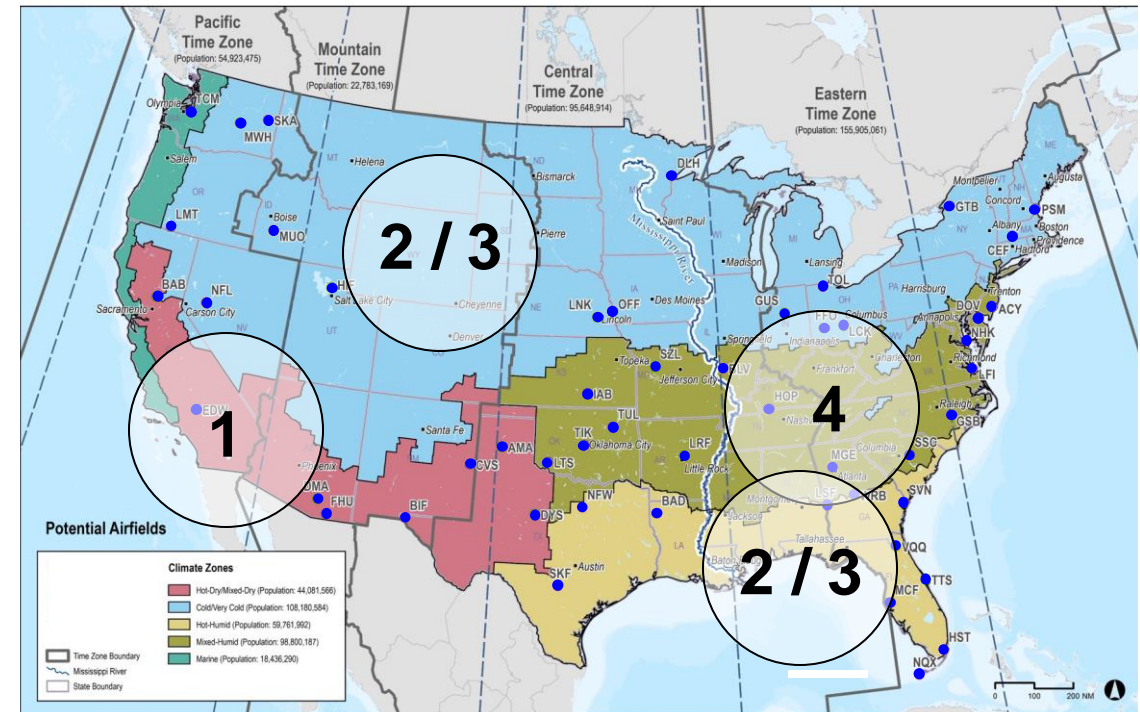
- **CT-1 candidate community identified; detailed evaluations in progress**

- Airfield is Edwards AFB
- Defined geographic boundaries and nominal flight path
- Carpet and flight path variation being evaluated
 - Historical weather influences
 - Airspace coordination and planning

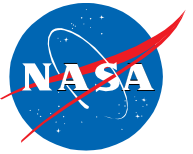


- **Continuing visits to CT-2+ candidate airfields**

- Assessment of available infrastructure
 - Hangar space
 - Security
 - Ground Support Equipment
- Integration with airfield operations
 - Amount of ground/flight operations
 - Impact of anticipated future activities (e.g., runway closures)
 - Seasonal considerations (e.g. weather, bird migration, etc.)
- Local airspace coordination considerations



Survey System Checkout Test Completed



- **Conducted in Nashville, Tennessee**

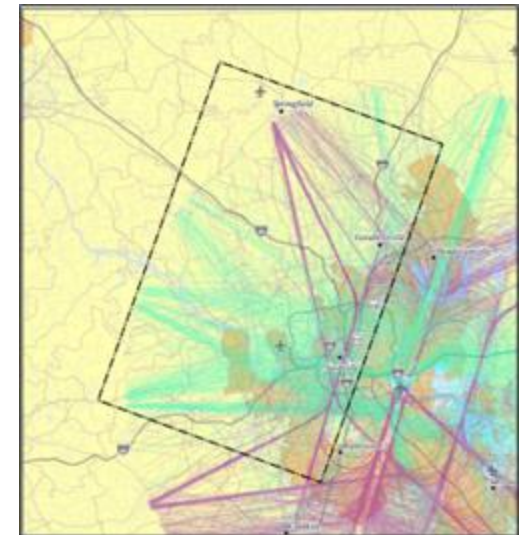
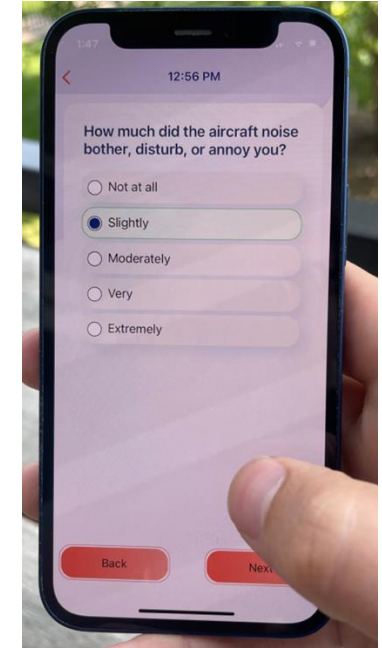
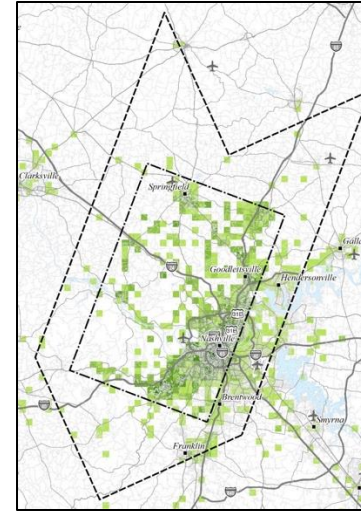
- Enrollment August-October 2023
- Survey study November 2023
- ~ 600 survey participants
- Multiple surveys during the day

- **Survey execution and data system operation**

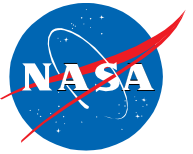
- Survey instrument
- Participant recruitment and retention (paid incentive)
- Communications/tech support
- User interface for viewing survey results
- No NASA-directed overflights (survey questions were on general aircraft sound)

- **Results/Lessons learned**

- Successful execution of full process
- Participation and response rates above expectations
- Addressing improvements to internal processes
- Progressing with integrating survey system with overall data system for community testing



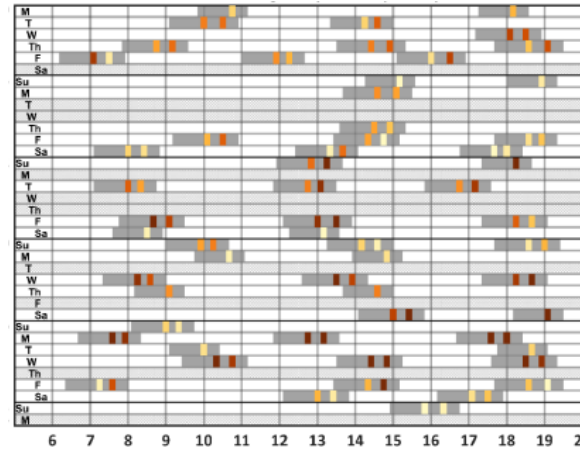
Survey Design and Analysis



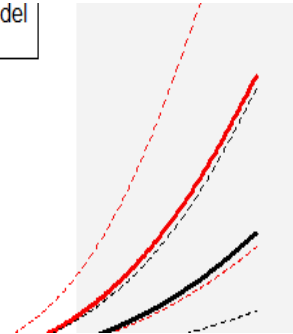
• Exposure scheduling

- Distribution of dose level across loudness range
 - Range may vary for each community test
 - Resolution/fineness
 - Weighting
- Randomization over month-long test
 - Weekday/weekend
 - Time-of-day (waking hours only)
 - Adjustable to interruptions or flight ops considerations
 - Maintenance, Weather
 - Fatigue rules

Example of month-long exposure schedule



'0,7,4) Exposure Model
'0,7,4) 90% CI



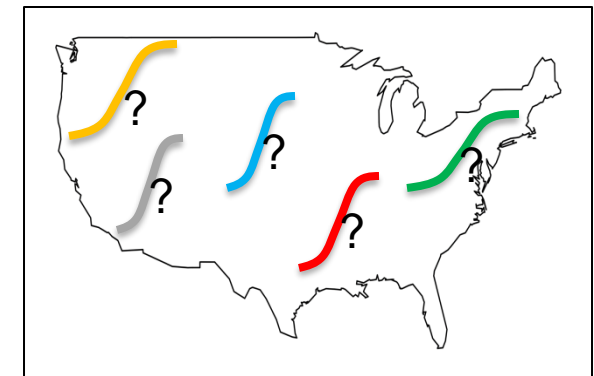
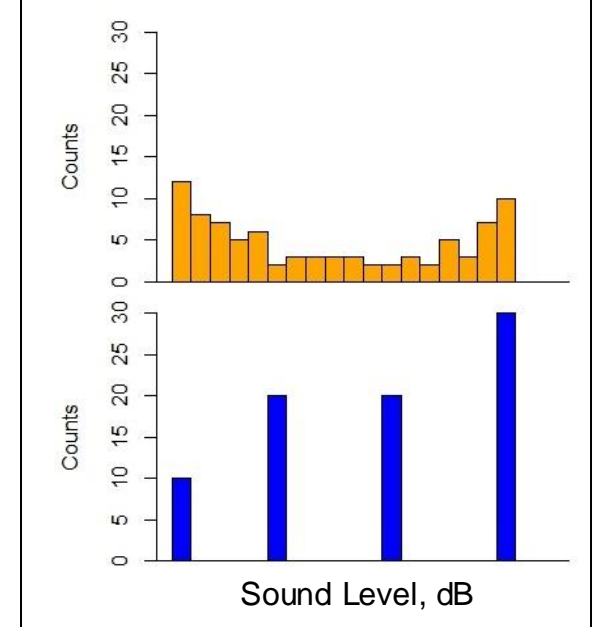
• Influence of dose error

- Uncertainty in exposure level impacts dose-response analysis
- Addressing strategies to mitigate

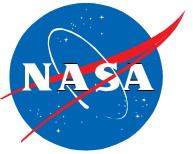
• Interpretation/combining of results from multiple sites

- Limited number of community tests
- Potential for inconsistency in dose-response relationships

Examples of dose distribution approaches

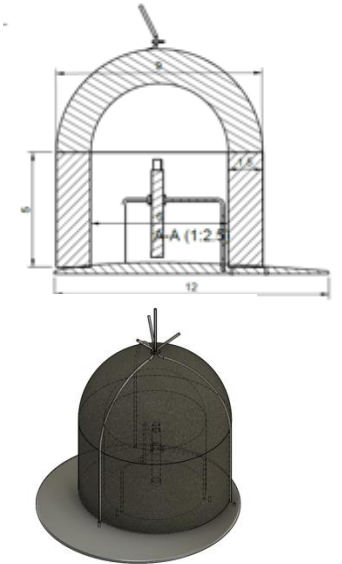


Exposure Measurement



- **Support Hardware for Ground Recording System units**

- Windscreen
 - Effects of windscreen size
 - Weather robustness
 - Evaluated during CarpetDIEM III
 - Final design rejects more wind noise than traditional windscreen
 - Units under fabrication
- Ground plate
 - Microphone/windscreen attachments
 - Accommodating calibration hardware
 - Final design underway



- **Meteorological Measurement requirements finalized**

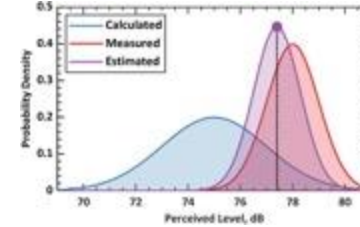
- Determined sensitivity/significance of key parameters for exposure estimation
- Developing NASA and contractor proficiency for unique hardware types



Exposure Estimation

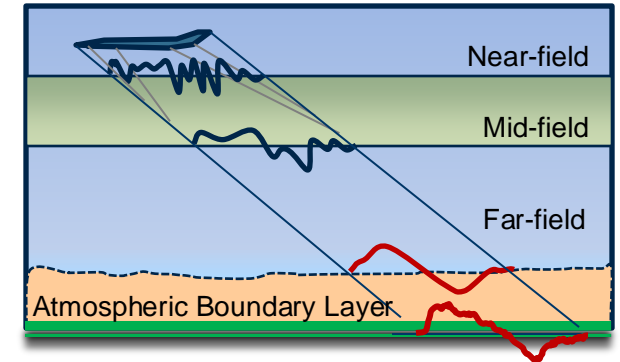
- **Overall exposure estimation = GRS measurements + predicted/calculated levels**

- Addresses uncertainties in measurement and calculations
- Incorporates variability of atmospheric turbulence



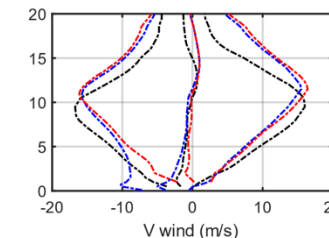
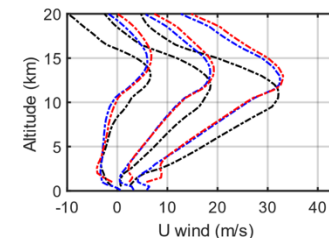
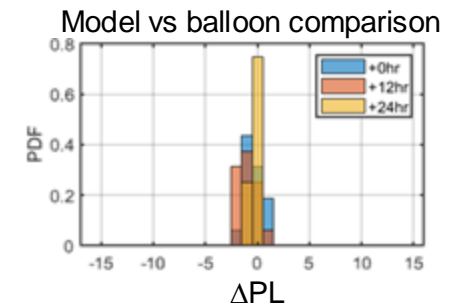
- **Sonic boom propagation modeling and metrics improved**

- PCBoom updates for Phase 3 atmospheric turbulence modeling needs
- Narrowband Octave-band Metrics (NOM) source code updated and released
- Available for use by international sonic boom research communities

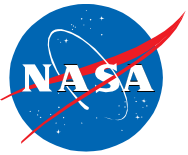


- **Forecast Atmospheric Profile Tool developed**

- Input to propagation modeling and flight planning tools to achieve target sound level
 - X-59 configuration
 - Flight track
- Validation cases for multiple parameters and locations
- Wind, temperature, humidity, etc.



Quesst Mission Phase 3 Overall Timeline



2019 - 2026	2027 +
<i>Planning Stage</i>	<i>Execution Stage</i>
<ul style="list-style-type: none">• Develop overall Community Testing plans<ul style="list-style-type: none">○ Survey design○ Exposure estimation○ Data system development○ Public outreach and communication• Risk reduction activities<ul style="list-style-type: none">○ Survey system checkout test○ Acoustic monitor and infrastructure checkout○ Automated data processing validation○ Integrated testing of data system components• Obtain feedback on survey methods and exposure estimation approaches<ul style="list-style-type: none">○ ICAO CAEP Working Group 1 participation○ Virtual and in-person international workshops○ Independent review panel	<ul style="list-style-type: none">• Community Test 1 near NASA Armstrong• Additional community tests<ul style="list-style-type: none">○ Various regions○ Participant demographics• Survey and exposure data analysis• Develop dose-response relationship• Aggregate analyses and extend to nationally-representative database• Data delivery to regulators



Thank You!

Any QUESTions?

