Overview of Community Response Test Campaign with NASA's X-59 Aircraft

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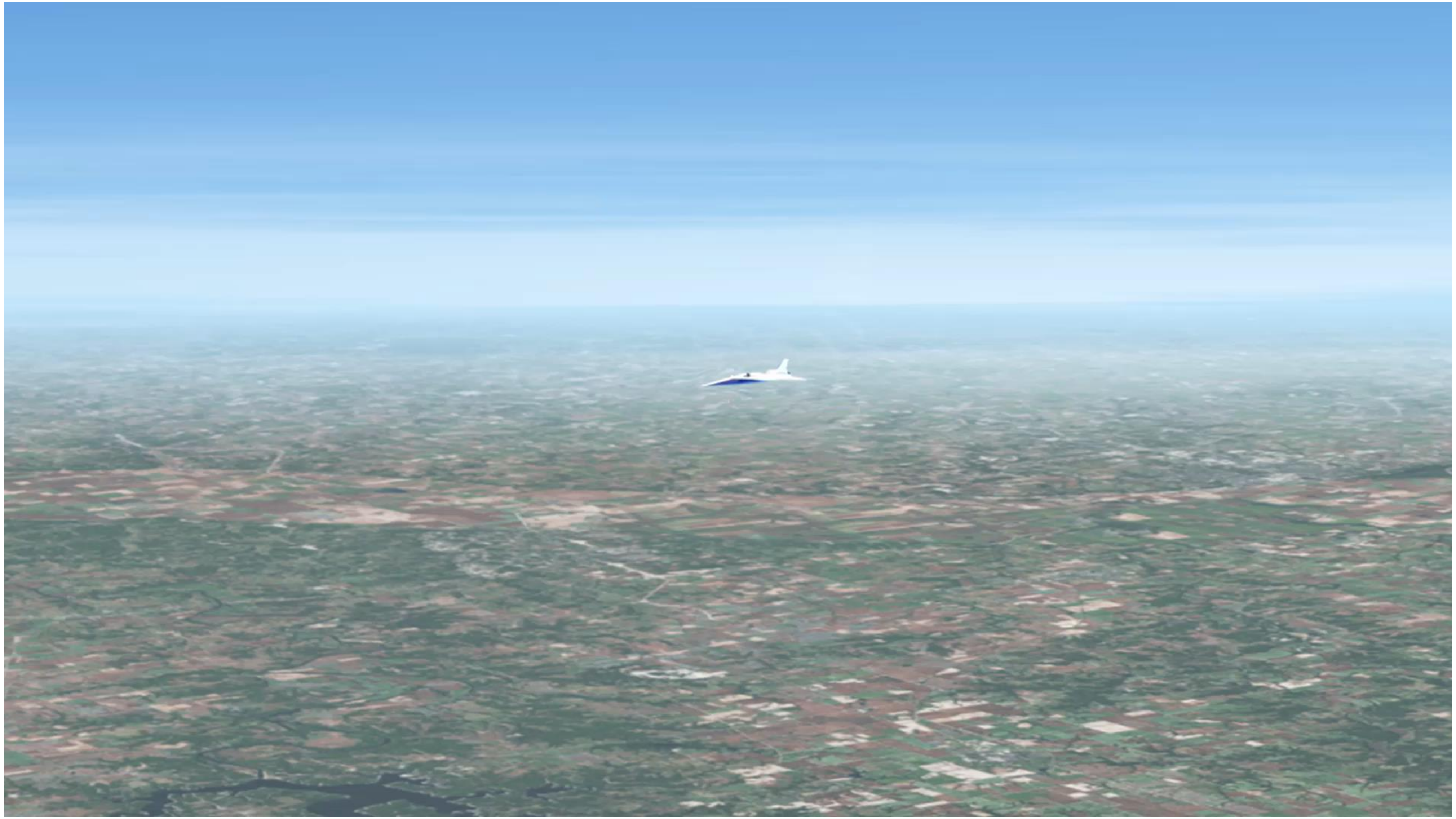
Sonic Boom Moves With The Aircraft



Speed Limit Or Noise Limit?

14 C.F.R. § 91.817 Civil Aircraft Sonic Boom

(a) No person may operate a civil aircraft in the United States at a true flight Mach number greater than 1…

(b) In addition, no person may operate a civil aircraft for which the maximum operating limit M_{M0} exceeds a Mach number of 1, to or from an airport in the United States…

The Quesst mission will collect data to inform regulation of civil supersonic flight over land.

The Quesst Mission

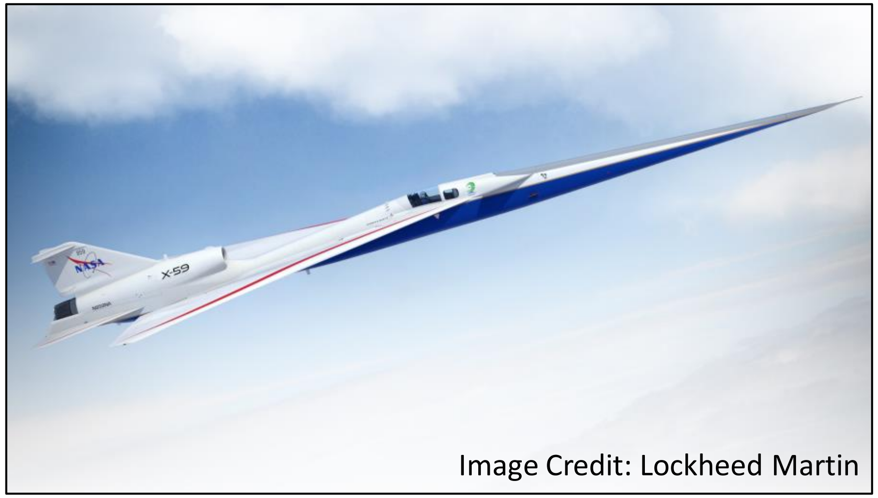
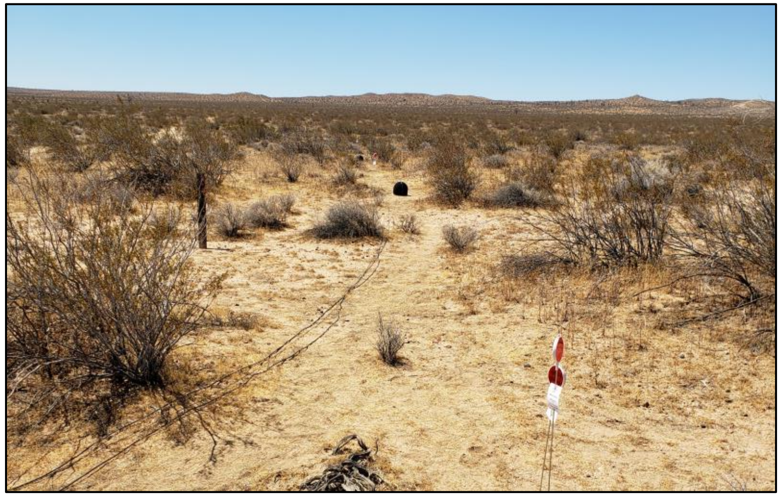


Image Credit: Lockheed Martin



Phase 1—X-59 Aircraft Development

- Detailed design
- Fabrication, integration, ground test
- Checkout flights
- Subsonic envelope expansion
- Supersonic envelope expansion

Phase 2—Acoustic Validation

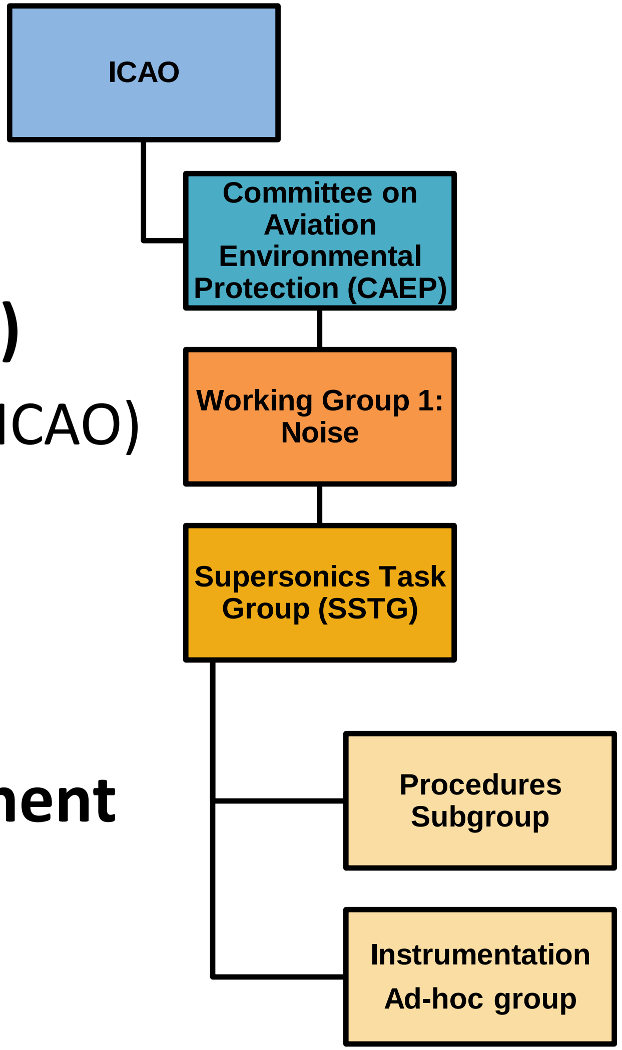
- In-flight and ground measurements
- Validation of X-59 signature and prediction tools
- Development of acoustic prediction tools for Phase 3

Phase 3—Community Response

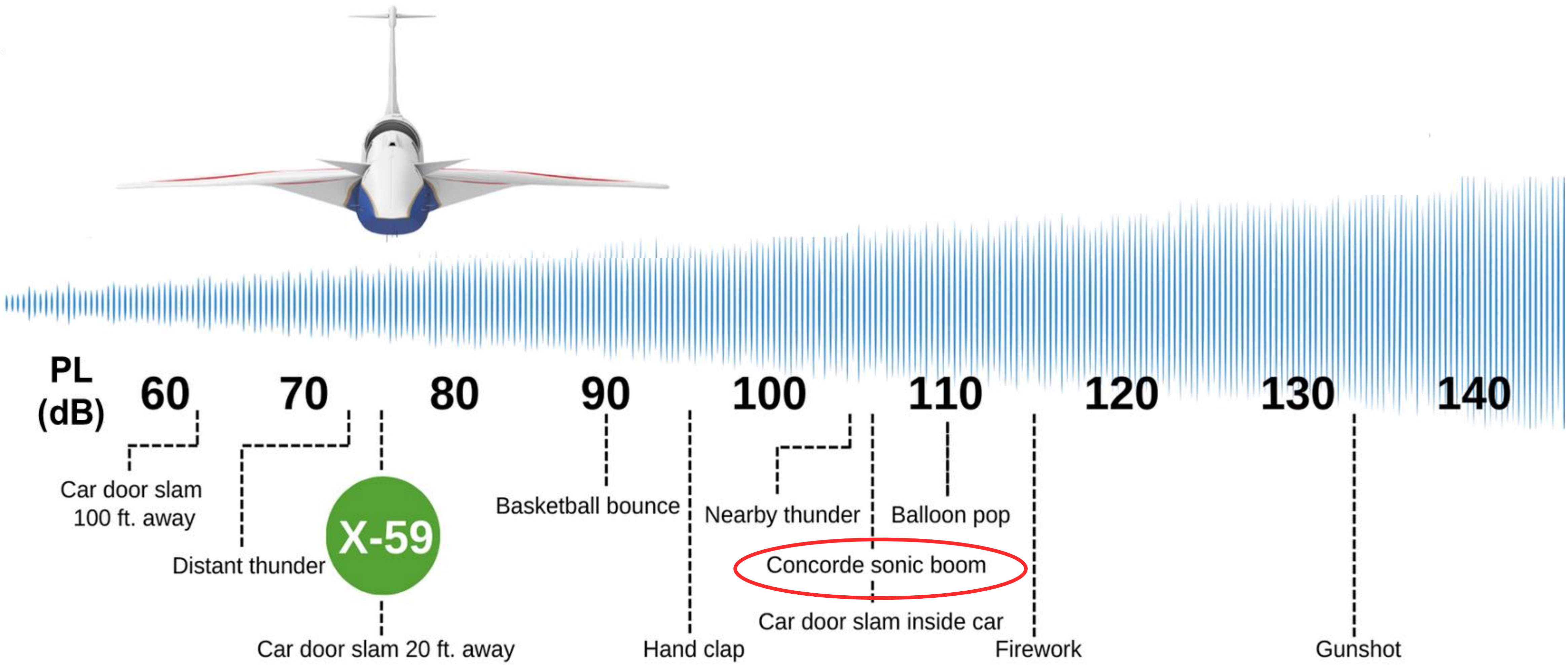
- Multiple campaigns across U.S.
- Community response surveys
- Ground measurements in communities
- Data analysis
- **Database delivery for regulators**

National and International Regulatory Entities

- **Federal Aviation Administration (FAA)**
  - FAA Reauthorization Act of 2018—Pub. L. 115-254 § 181
- **Committee on Aviation Environmental Protection (CAEP)**
  - Committee within International Civil Aviation Organization (ICAO)
  - FAA is United States representative to CAEP
  - NASA serves as technical advisor to FAA
- **NASA community test data support standards development**



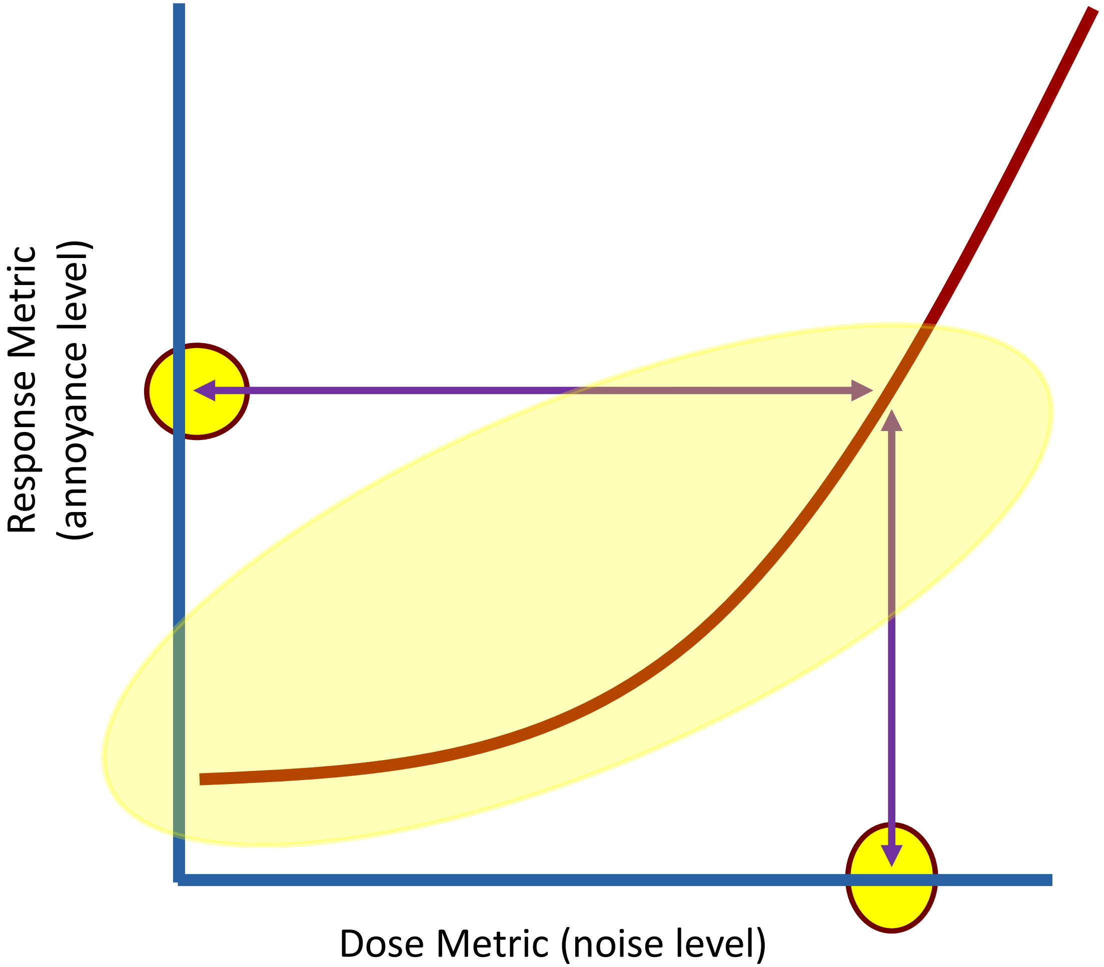
How Quiet Could Future Quiet Supersonic Transports Be?



Doebler and Rathsam (2019)

Community Testing Research Questions and Products

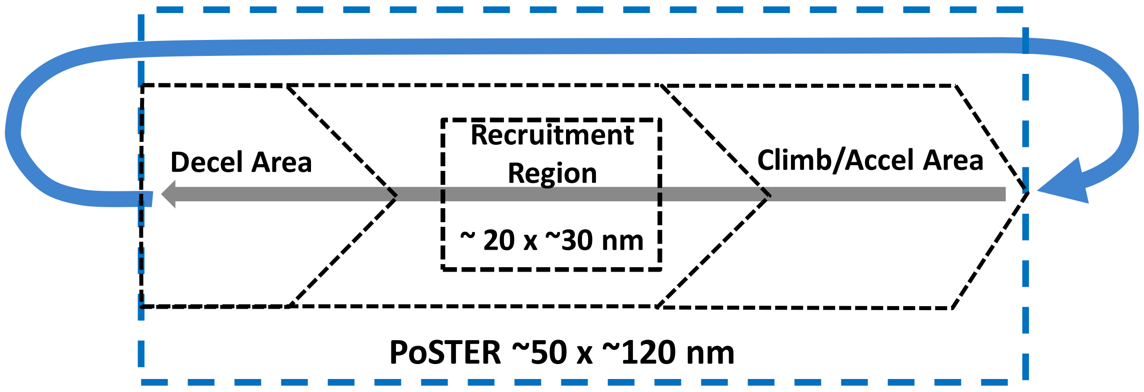
- **Produce dose-response models**
  - Single flyover events
  - Cumulative dose
- **Assess effects on annoyance**
  - Rattle, vibration, startle
  - Listening environment, time of day
- **Outside of mission scope**
  - Sleep disturbance
  - Takeoff/landing noise, emissions

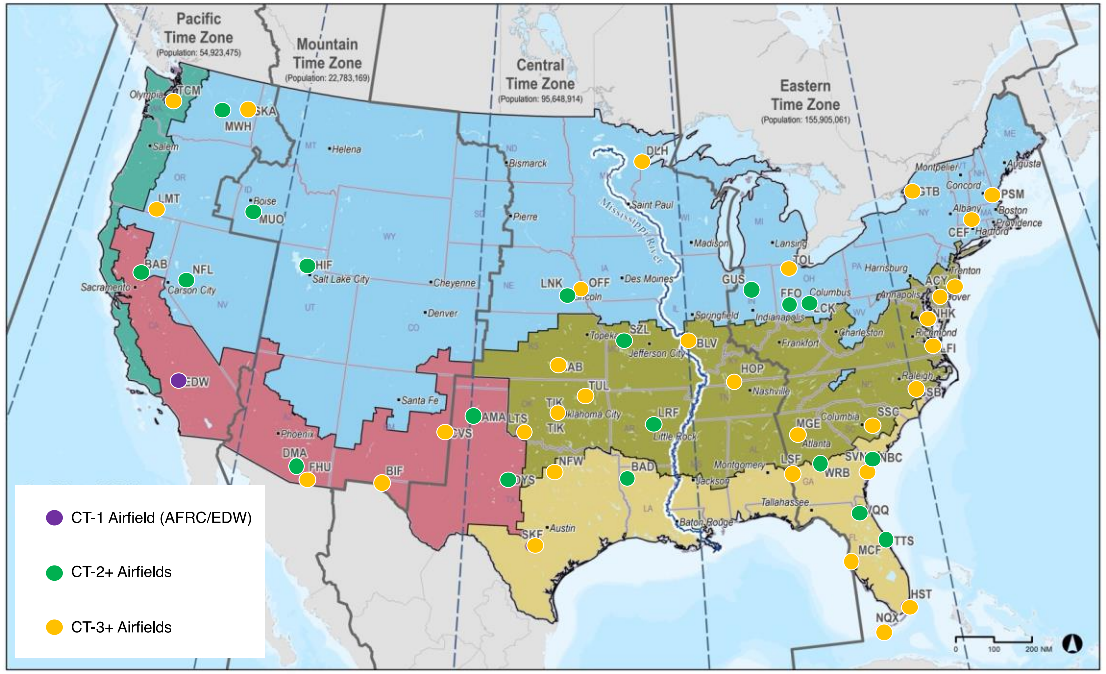


Airfield and Community Test Site Selection

- **Four to six planned tests in 2025-2027**
  - Conduct first test from NASA Armstrong
  - Future airfields to be determined
- **Technical, aircraft-related constraints**
  - Runway, airfield infrastructure
  - Emergency, alternate landing sites
- **Ensuring representativeness**
  - Regional variation (Doebler et al. 2022b)
  - Demographic diversity

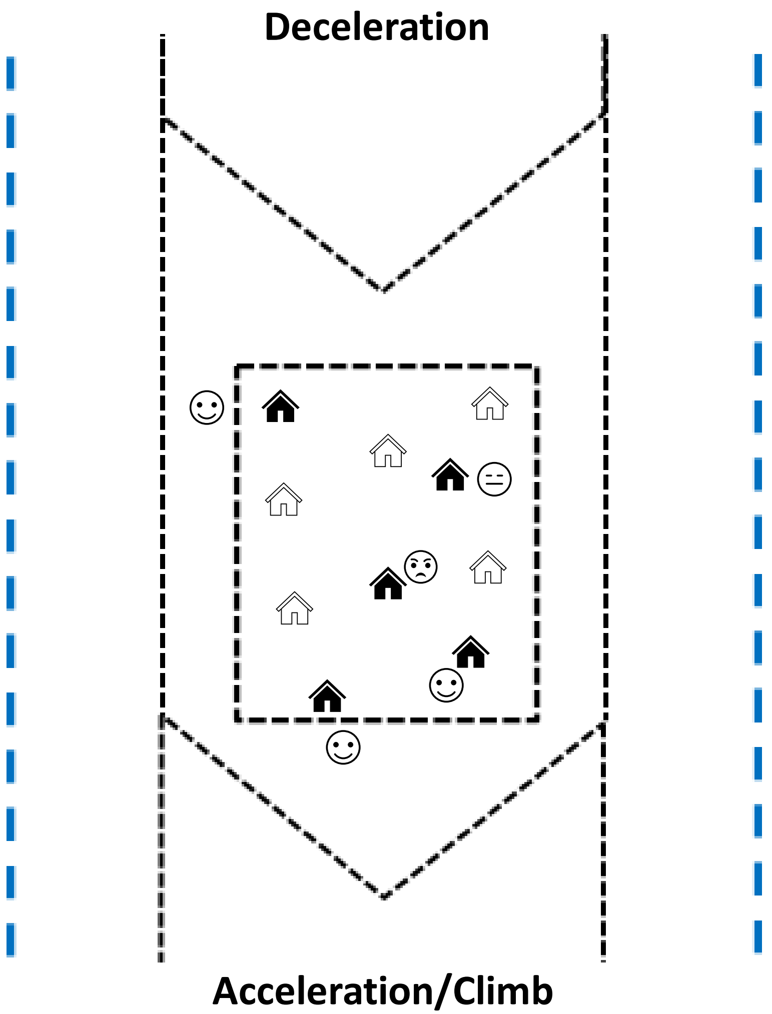
Notional Supersonic Flight Path





Collecting Responses With Longitudinal Surveys

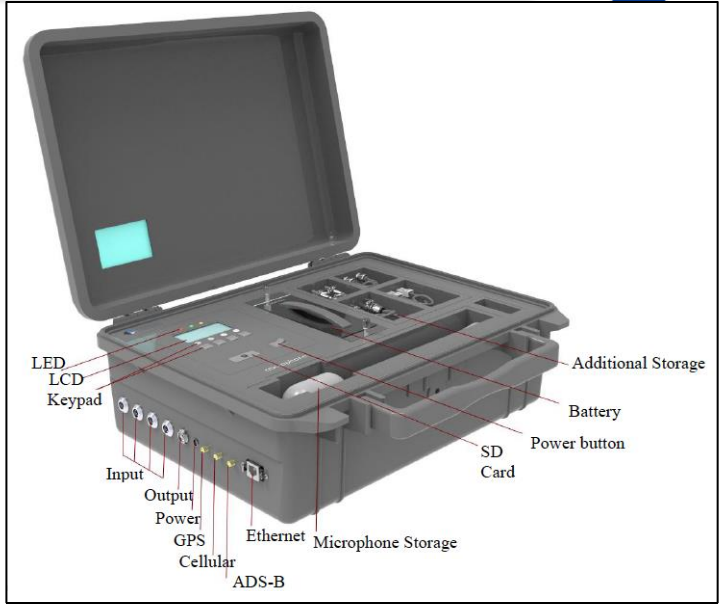
- **Deploy repeated single-event, daily summary surveys**
  - Near-real-time need for ~100 passes during one month
  - Survey modes: internet, custom smart phone apps
- **Population: all residents in recruitment region**
- **Sample: panel of ~1,000 residents in community**
  - Take every nth household on sorted list
  - Within-household sampling

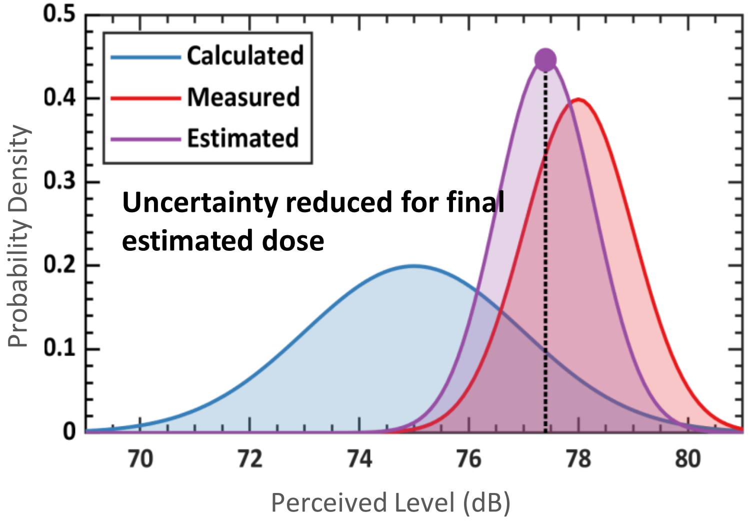


(Notional Figure)

Noise Exposure Design, Estimation, and Analysis

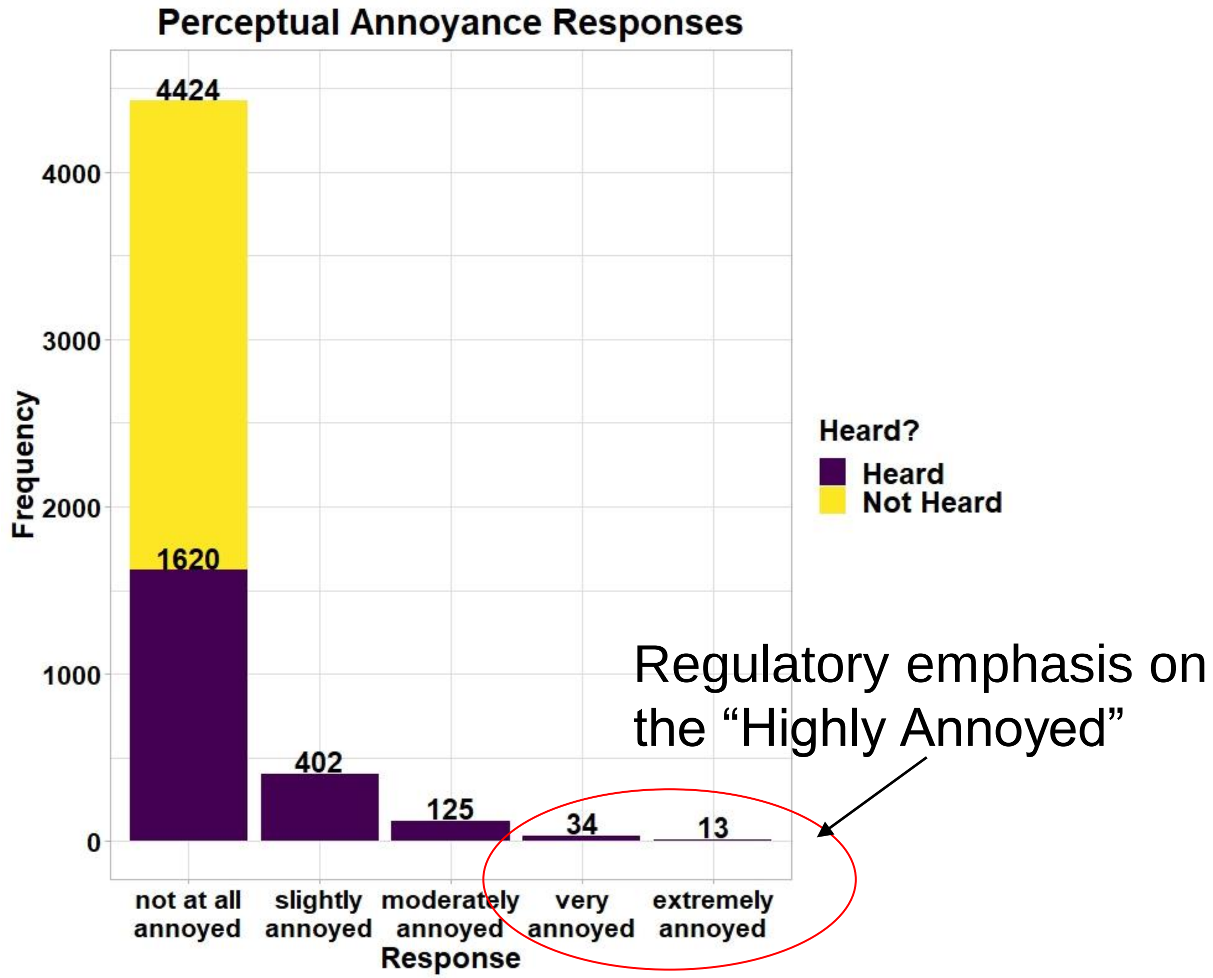
- Estimation, refinement of attainable noise levels
- Noise exposure scheduling tool developed
- Meteorological data needs identified
- Progress of Ground Recording System (GRS)
- Components of dose estimation and uncertainty

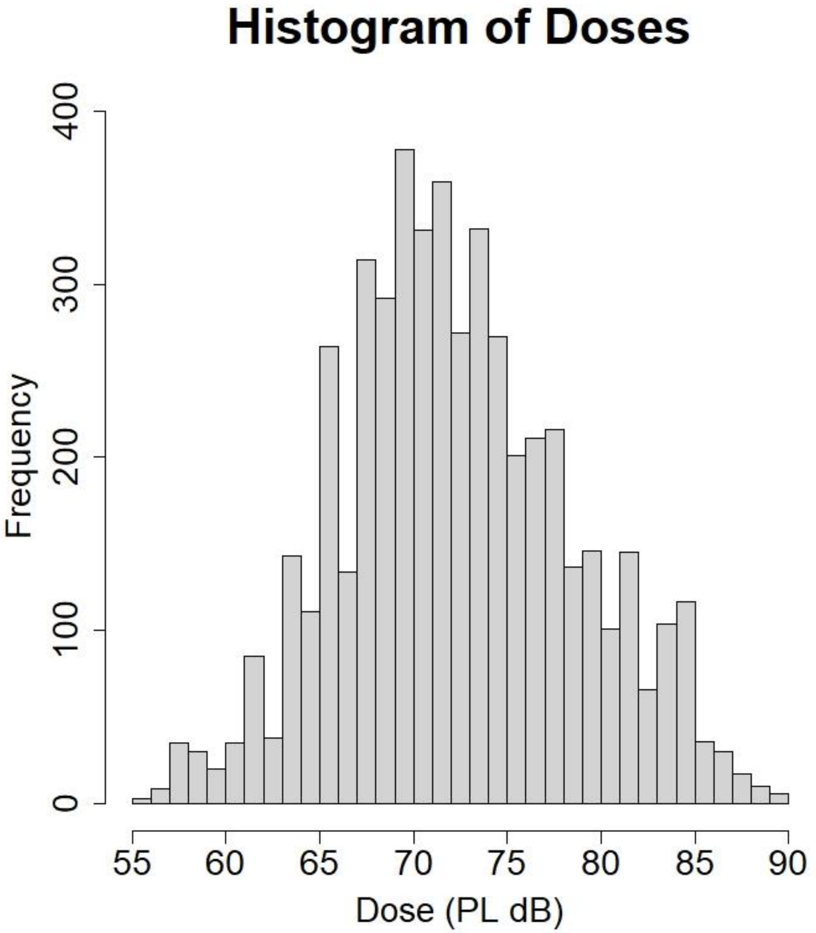




Source: Lympany et al. (2022b)

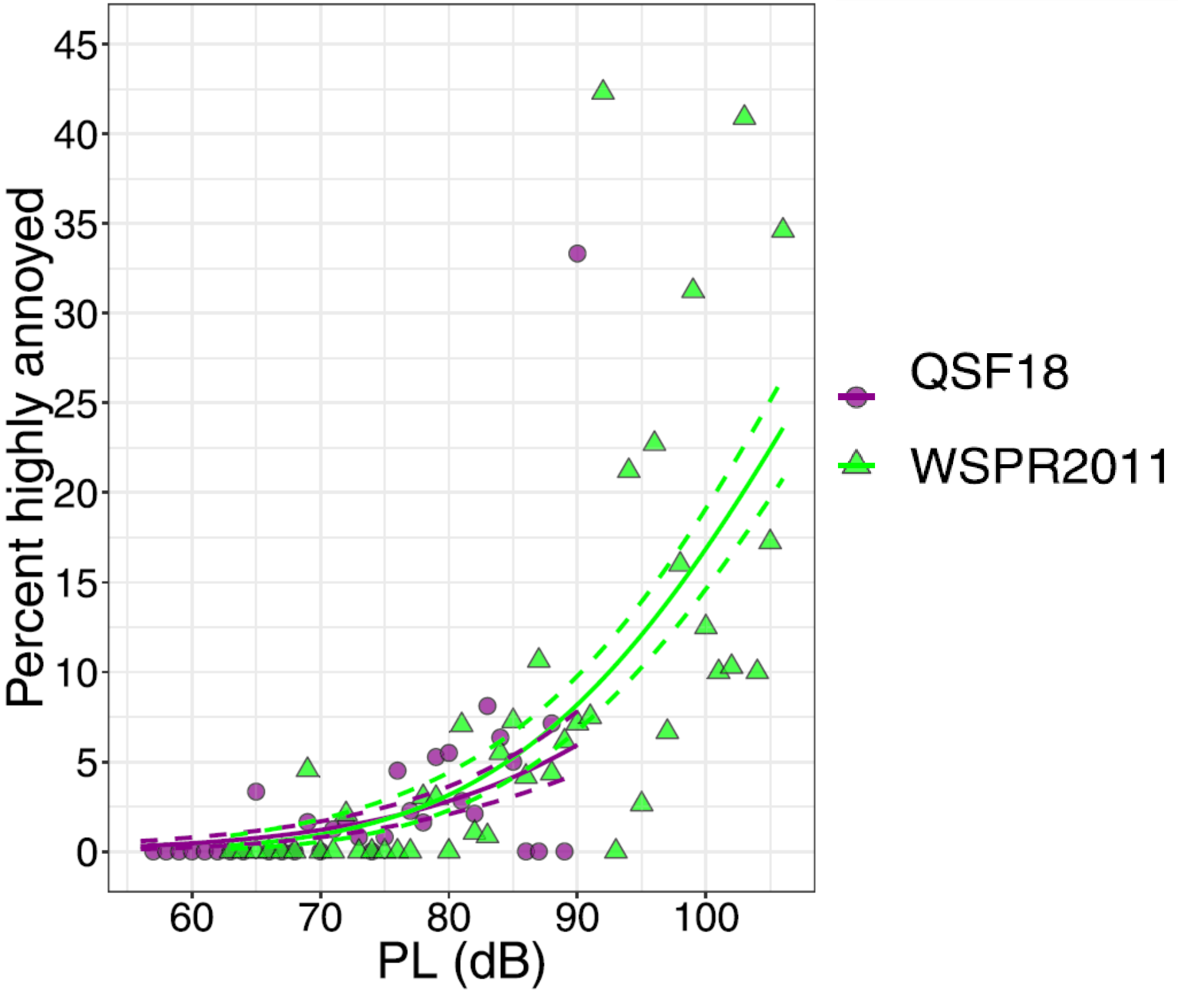
What Might We See in Collected Data?





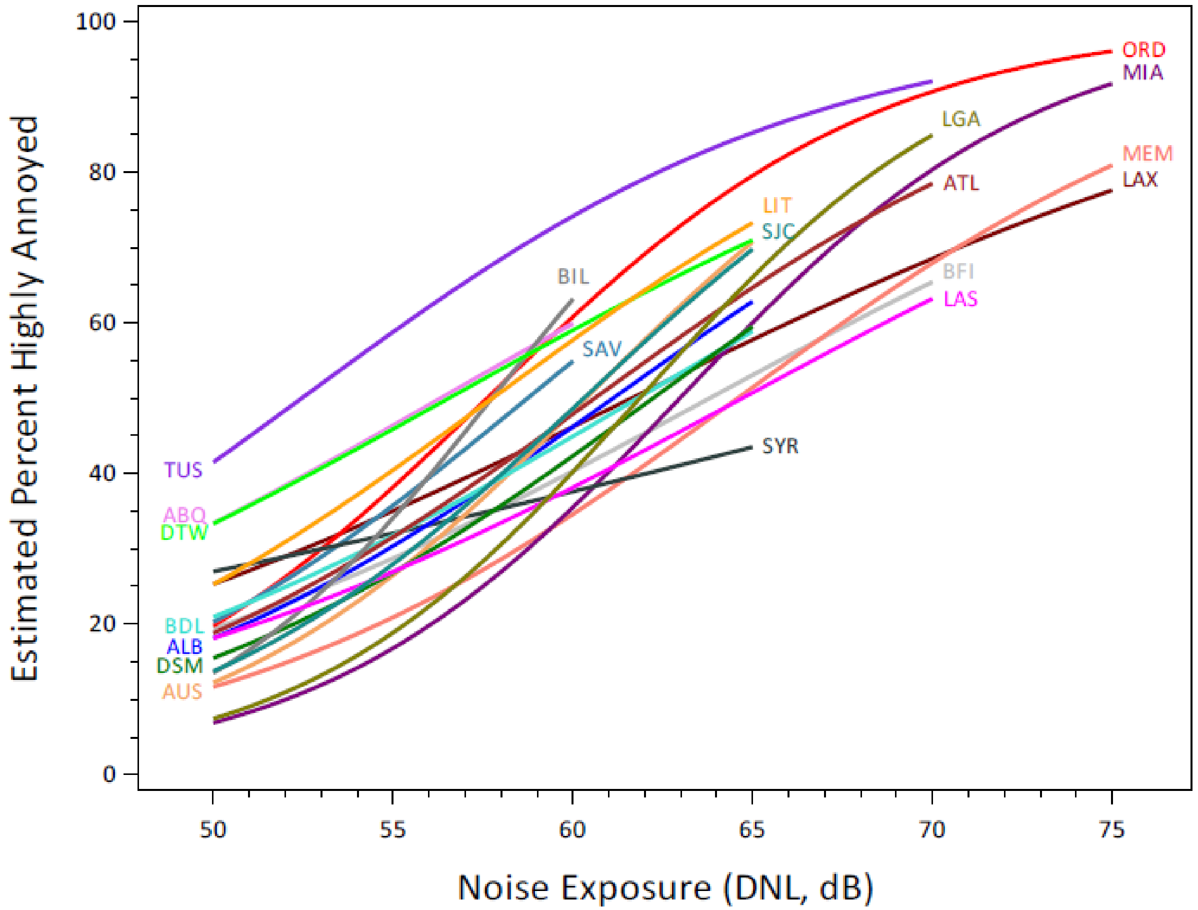
- **Quiet Supersonic Flights 2018 Study (QSF18) in Galveston, TX**
  - Page et al. (2020a,b), Lee et al. (2020)

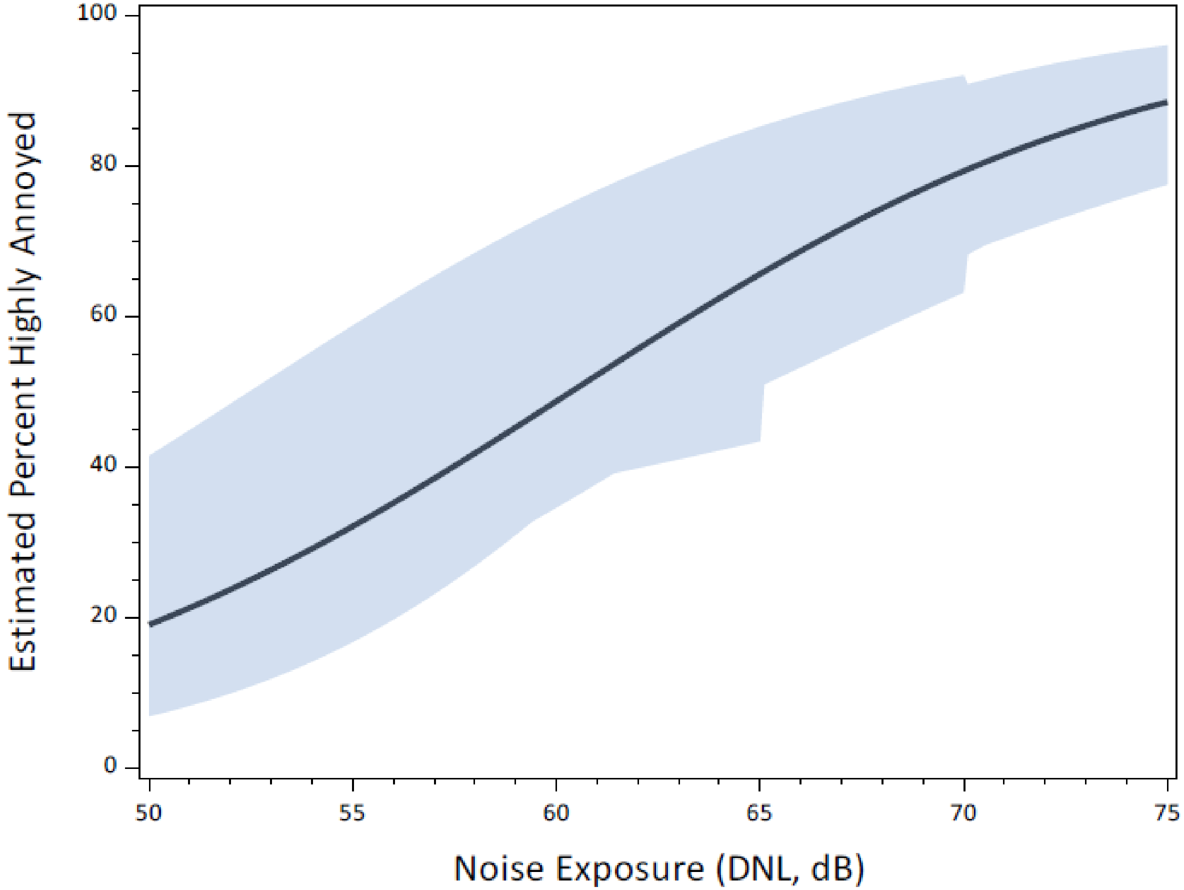
Dose Response Curves From Past NASA Studies



- **Waveforms and Sonic Boom Perception and Response 2011 at Edwards AFB**
  - Page et al. (2014); comparison with QSF18 dose response curves in Lee et al. (2020)

Toward National Dose Response Curves





- ***Analysis of the Neighborhood Environmental Survey*** **(Miller et al. 2021)**
  - Note cumulative, A-weighted Day Night Level metric

Conclusions

- Quesst mission culminates in community test campaigns
- Anticipate first flight of the X-59 later this calendar year
- Beginning in 2025, community testing will contribute data for regulation
- If the speed limit restricting civil supersonic flights over land is replaced with a noise limit, what should that limit be?

Thank You!

QUESST

https://www.nasa.gov/quesst

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Supplement: NASA is Building the X-59 Research Aircraft

Image Credit: Lockheed Martin

- Flights will confirm that a full-scale supersonic aircraft can produce just a gentle sonic “thump”
- Key data will be gathered on public perception of quiet supersonic flights in several cities across the nation

Length
99.7 feet long

Width
29.5 feet wingspan

Cruise Speed
Mach 1.4

Cruise Altitude
55,000 feet

Supplement: X-59 Design Features

Quiet design approaches adapted for a unique flight demonstrator

Image Credit: Lockheed Martin

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