

UNWG Perspective on Noise in the Vertiport Environment

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NASA Glenn Research Center

Presented By:

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UNWG EC Committee

SG1 (**Tools and Technologies**) Leads

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SG2 (Ground and Flight Testing) Leads

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SG3 (Human Response and Metrics) Leads

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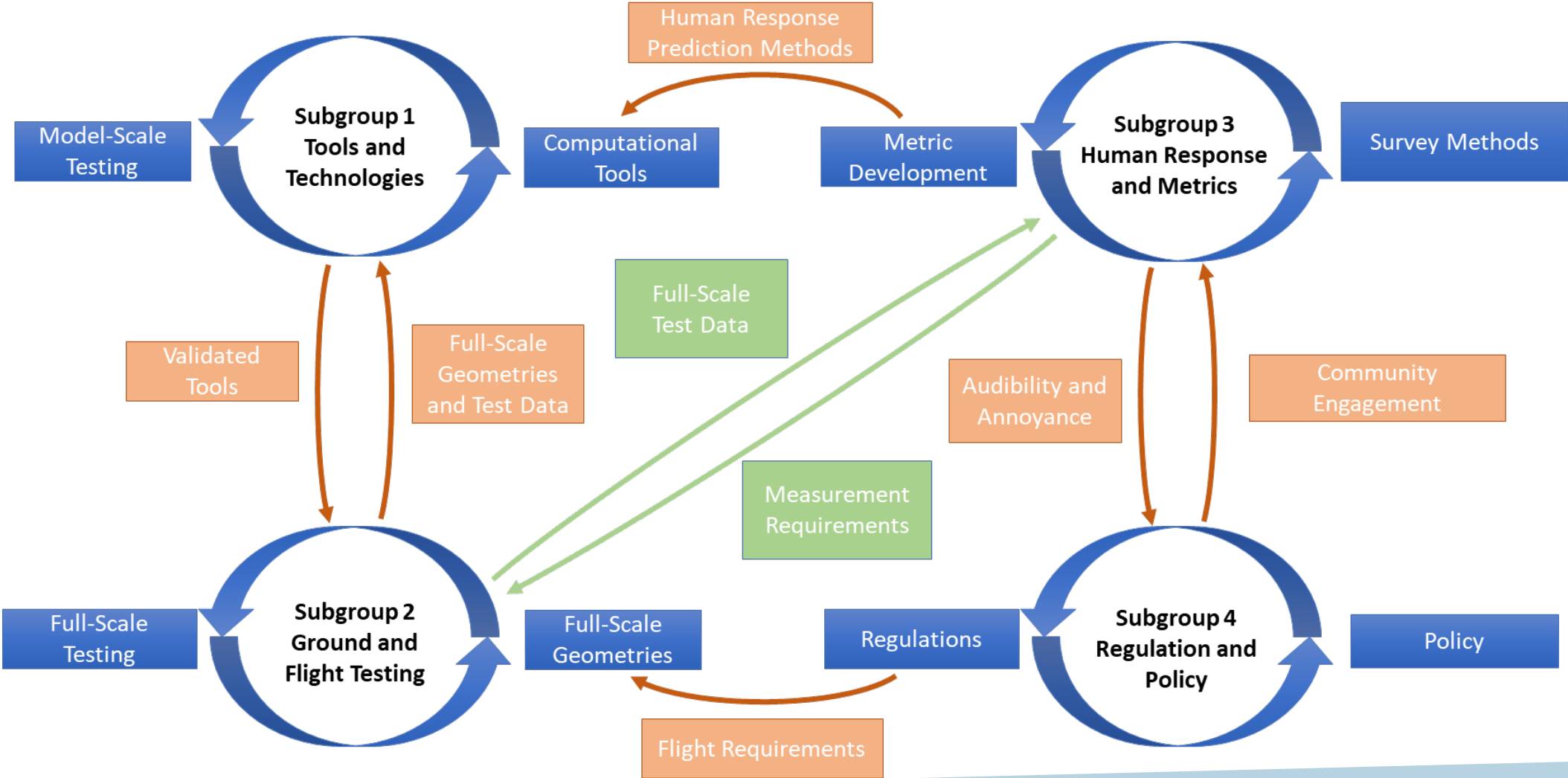
SG4 (Regulation and Policy) Leads

Royce Snyder (Bell Flight), Bill He (FAA)

UNWG Chairs

Brenda Henderson, Stephen Rizzi

Significant Subgroup Interactions



Subgroup I: Tools and Technologies

Vertiport Challenge for Noise Prediction

- SGI: Tools and Technologies is focused on developing validated tools
 - Current focus has been on isolated and installed propellers at model scale
 - Significant research needs to be performed at scale for isolated propellers
 - Relation between model scale and full scale still needs to be determined
 - Installation and maneuver capabilities still need to be validated
- UNWG intra-subgroup collaboration required for vertiport noise
 - High-quality computed aircraft noise predictions (SG1)
 - Need to be validated by flight test (SG2)
 - Comparing appropriate metrics (SG3)
 - With an understanding of the complex regulatory environment (SG4)

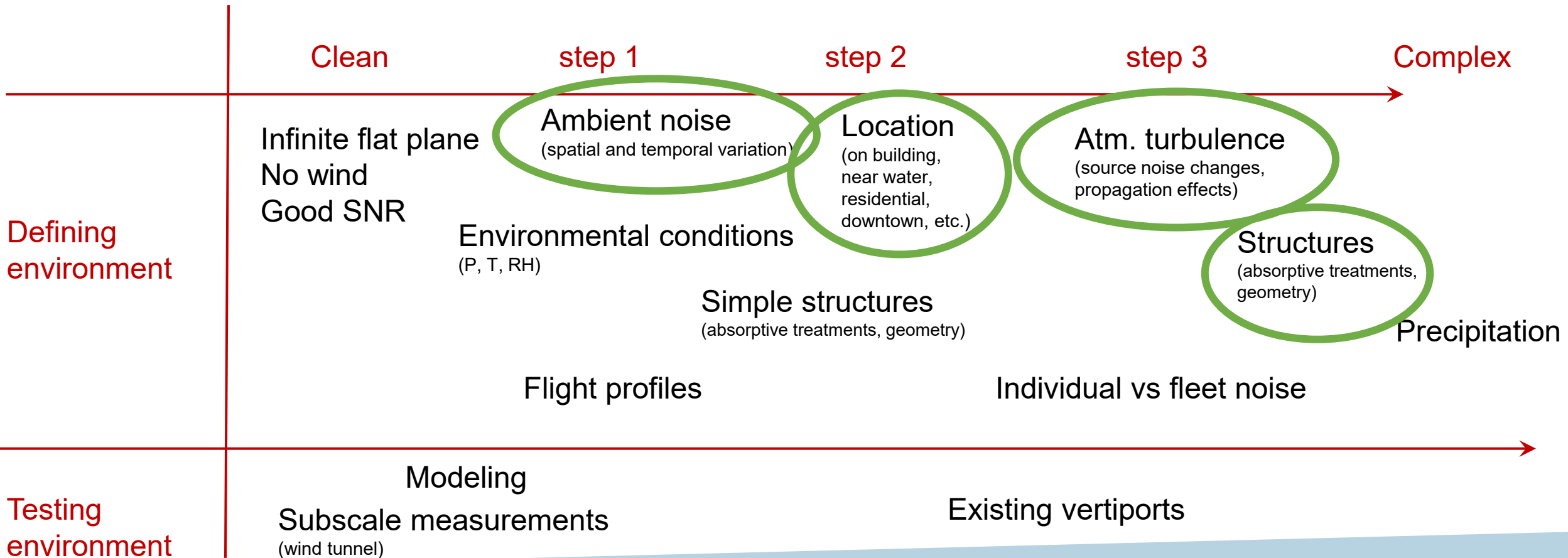
Vertiport Noise Prediction

- Requirements for predicting noise in the vertiport environment
 - Full-scale validation (SG2) data are key for tool development
 - Requires public geometries and data (aerodynamic and acoustic)
 - Public geometries must be realistic and not proprietary
 - Many data sets from multiple facilities/entities ensure accurate data
 - Accurate source noise methods
 - UAM source noise methods are still being developed and validated
 - Source noise identification paramount
 - Relation between model scale and full scale still needs to be clearly defined

Subgroup 2: Ground and Flight Testing

Roadmap to Reality: Understanding UAM Vertiport Noise

Assess/quantify/measure noise in complex environments for UAM operations



Ambient Noise

Topics for Consideration

- Spatial variation
- Temporal variation
- Ambient role in site selection and test planning
- Measurement techniques in different environments (urban, suburban etc.)
- Dose evaluation methods in the presence of ambient noise
- Techniques to extract the source signal from a complex ambient
- Identifying and quantifying ambient noise metrics and influence on dose-response relationship

Potential Collaboration

- SG1 (Tools and Technologies)
 - Ambient and environmental models (spatial/temporal)
 - Characterize pre-test (SNR expectations)
- SG3 (Human Response and Metrics)
 - Acoustic data requirements
 - Measurements (binaural, spatial etc.)
- SG4 (Regulation and Policy)
 - Metrics
 - Operational considerations

Topics of Interest

- Signal processing techniques
- Measurement techniques
- Quantifying the ambient environment
- Site evaluation

Atmospheric Turbulence

Topics for Consideration

- Changes in source noise emission in turbulence
- Propagation effects
- Spatial and temporal variation
- Measurement techniques in different environments (urban, suburban etc.)

Potential Collaboration

- SG1 (Tools and Technologies)
 - Source acoustic emission changes
 - Stochastic methods for both environmental and source quantification
- SG3 (Human Response and Metrics)
 - Influence of ambient on subjective interpretation and response
 - Uncertainty quantification needs and methods
- SG4 (Regulation and Policy)
 - Key environmental ranges for consideration and capture

Topics of Interest

- Environmental characterization
- Site selection and planning
- Model development and application

Site Evaluation and Measurement Locations

Topics for Consideration

- Site evaluation and selection
 - Urban, Suburban, Residential
 - Vertiport locations: near homes vs. downtown
 - Ground vs. elevated vertiports
- Characterize different kinds of:
 - Buildings – complexity, variety
 - Environmental considerations – winds, turbulence
 - Proximity to bodies of water
 - Operational tempo

Potential Collaboration

- SG1 (Tools and Technologies)
 - Data needs for modeling – environmental and source considerations (input and V&V)
- SG3 (Human Response and Metrics)
 - Locations for dose evaluation - ground, upper stories, indoor/outdoor, proximity to other ambient sources (road noise) etc.
 - Noise monitoring vs. dosimeters
 - Indoor vs. outdoor and at home vs. work
- SG4 (Regulation and Policy)
 - Metrics and data needs
 - Desired range of dose and ambient exposures

Topics of Interest

- Structural acoustic definition

Structures

Topics for Consideration

- Quantifying and describing the environment
 - Influence on eVTOL operational patterns
 - Effect on environmental / atmospheric parameters
 - Role in site evaluation and site selection
 - Relationship to ambient noise sources
- Structure geometry influences
 - Site evaluation
 - Operational considerations
 - Quantification of dose delivery
- Absorptive treatments on structures in the vertiport environment (glass, stucco etc...)

Potential Collaboration

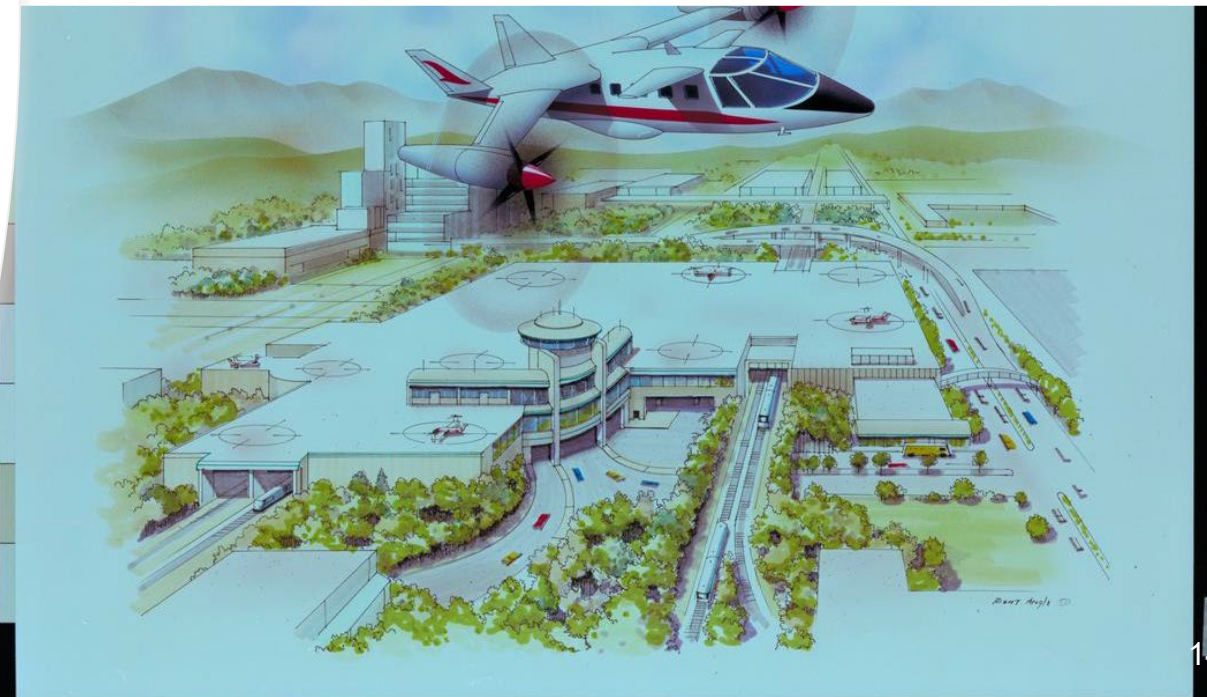
- SG1 (Tools and Technologies)
 - Influence of the built environment
 - Data needs for modeling
- SG3 (Human Response and Metrics)
 - Suitability of locations for dose evaluation
 - Indoor vs. outdoor and at home vs. work
- SG4 (Regulation and Policy)
 - Metrics
 - Data needs

Topics of Interest

- Structural acoustic definition
- Site evaluation – quantification, acoustic characterization, suitability assessment

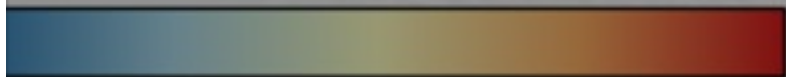
Subgroup 3: Human Response and Metrics

Models of vertiport environments can help analyze various aspects of UAM operations and human response

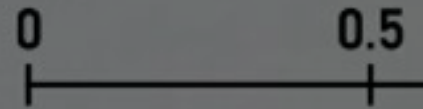


Need to understand how large an area around vertiports to focus on human response to UAM noise

Numerical Annoyance Rating



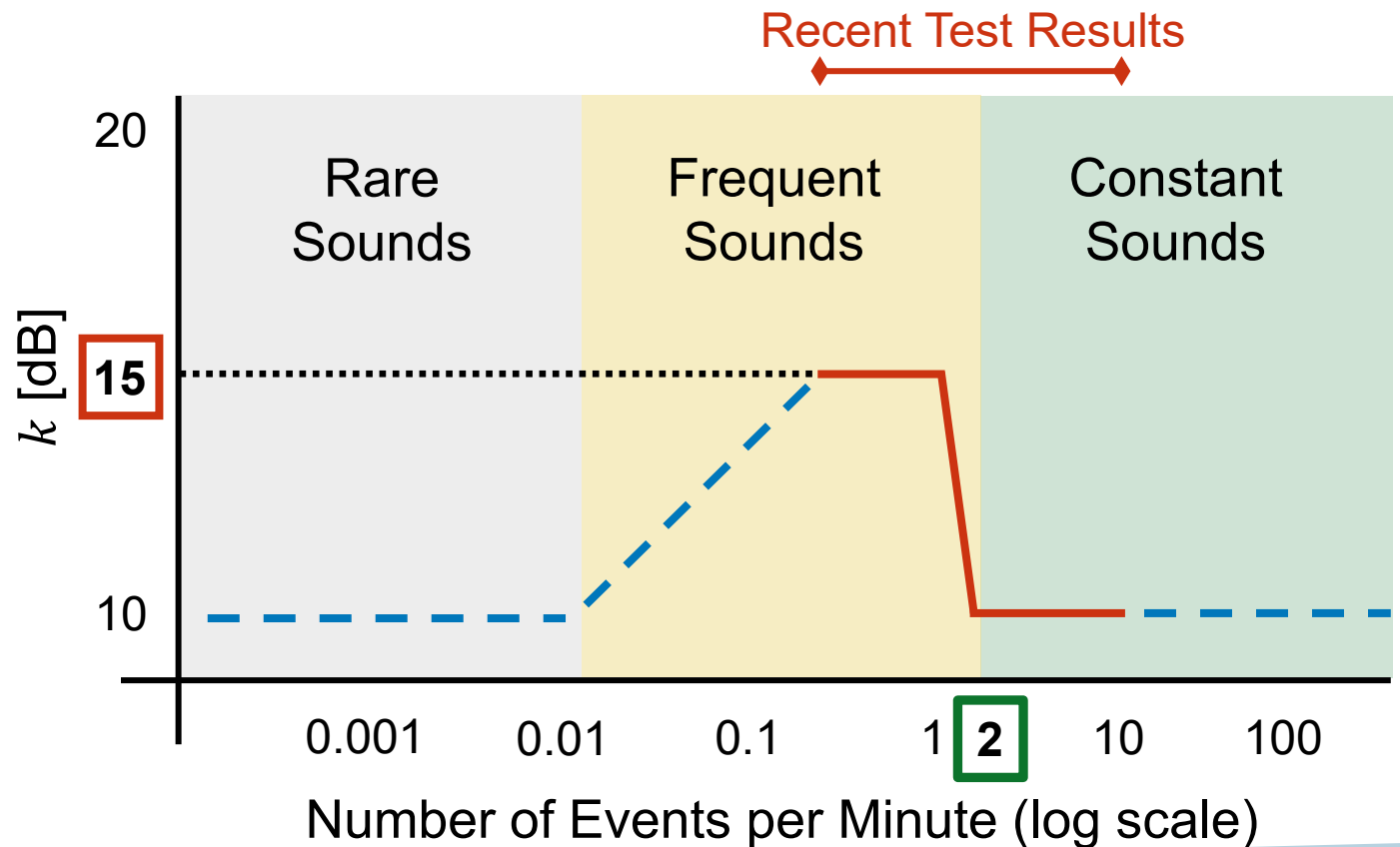
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UAM Operational Cadences

Estimates on realistic UAM operational cadences at vertiports will help focus human response testing

k is the number of decibels needed to decrease each operation to maintain the same annoyance when increasing the number of operations



There are lessons to learn from helicopter and drone operations



Defining noise abatement procedures requires collaboration within UNWVG and with OEMs

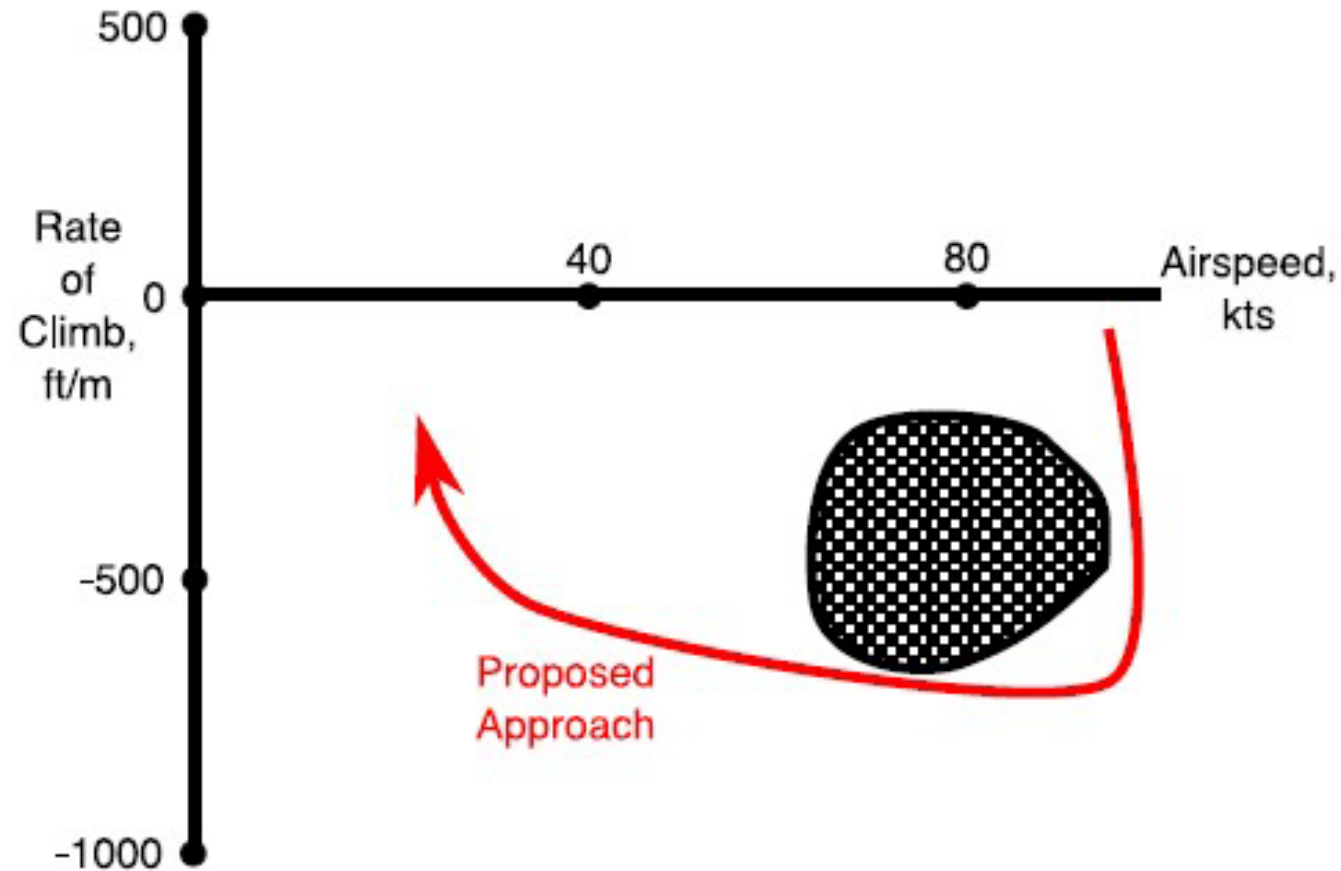


Image Source: Stephenson, J.H., et al., "Development and Validation of Generic Maneuvering Flight Noise Abatement Guidance for Helicopters," VFS 76, 2020. <https://ntrs.nasa.gov/citations/20205003220>.

Subgroup 4: Regulation and Policy

UAM Noise Working Group

Subgroup 4 – Regulation and Policy

Noise in the Vertiport Environment

- [Advanced Air Mobility Vertiport Considerations: A List and Overview](#)
 - **Federal Regulatory** was one of 18 groupings of considerations studied by the AAM Ecosystem Working Groups (AEWGs)
 - Vertiport funding and operating paradigms, as they pertain to state and municipality governance, will be dictated in large part as to how vertiports are both categorized and to what extent different government agencies have oversight and enforcement.
 - Vertiport funding and Public/Private-Use classification can affect FAA Regulatory Roles and Responsibilities (including 14 CFR Part 36 aircraft noise requirements) vs. state and municipality governance.

UAM Noise Working Group

Subgroup 4 – Regulation and Policy

Noise in the Vertiport Environment

- [Advanced Air Mobility Vertiport Considerations: A List and Overview](#)

- **Surrounding Uses** was another one of 18 groupings of considerations studied by the AEWGs

- The proximity of a vertiport to existing infrastructure is a primary siting factor; Infrastructure considerations include current local land use (e.g., school, hospital, park, or other noise sensitive areas)
- Potential vertiport locations may be selected for proximity to areas of anticipated high demand, such as business centers, sports/entertainment facilities, cargo distribution centers, and transportation centers (e.g., bus stations, train stations, traditional airports) → Each of these is likely already located in an area with favorable zoning for industry, business, and a future vertiport
- However, many cities recognize the need to protect residential and similar areas. For example, zoning ordinances in Los Angeles County, California state, “Residential Zones preserve, protect, and enhance areas for residential land uses in a range of densities;These zones also provide for the appropriate location of public and semi-public uses such as schools, parks, and religious facilities that can serve and complement residential uses.” It is in these locations or other sensitive locations where local groups are most likely to raise concerns about privacy, safety, noise, and traffic.

UAM Noise Working Group

Subgroup 4 – Regulation and Policy

Noise in the Vertiport Environment

- [Advanced Air Mobility Vertiport Considerations: A List and Overview](#)

- **Surrounding Uses** (CONTINUED)

- Vertiport access should also be addressed during planning. ... the airspace approach and departure corridors should be designed to reduce noise impact to **identified sensitive areas** with the potential for additional noise constraints for vertiports near particularly sensitive areas.

UAM Noise Working Group

Subgroup 4 – Regulation and Policy

Noise in the Vertiport Environment

- [Advanced Air Mobility Vertiport Considerations: A List and Overview](#)
 - **Environmental and Equity** are also assessed among 18 groupings of considerations in a study by the AEWGs
 - **Noise** and potential emissions concerns need to be assessed to assure that the NEPA and any relevant local levels are met, otherwise additional mitigations may be required.
 - Social equity is concerned with providing impartiality, fairness, and justice to all members of the community. Such social equity considerations include ensuring individuals across socioeconomic demographics realize benefits from AAM services and that negative impacts of operations (e.g., **noise**, visual pollution) are also appropriately distributed.

Concluding Remarks

Advancing noise assessments/predictions for the vertiport environment from an UNWG perspective requires advancements in all subgroup areas and interactions between the subgroups will be required

- Prediction tools need datasets for validation
- Experiments and validation datasets need to be designed with input from groups developing prediction tools and metrics as well as from individuals involved with policy and regulation
- Development of metrics for assessing community impact will require datasets acquired in relevant environments
- Policy and regulations need adequate data including vehicle measurements/predictions and human responses

Overall recommendation is to enhance subgroup interactions – potential to incorporate this in future UNWG meetings