ASCENT Project 003

Cardiovascular Disease and Aircraft Noise Exposure

Boston University School of Public Health

PI: Junenette Peters

PM: Donald Scata and Sean Doyle

Cost Share Partner: Donators to Nurses' Health Study

Collaborators: Harvard & MIT

Objective:

To evaluate the relationship between aircraft noise exposure and health including hypertension and sleep disturbance in existing health cohorts – Nurses Health Studies (Health Impacts)

To assess economic benefits or harm to businesses underneath regular flight paths at selected airports (Economic Impacts)
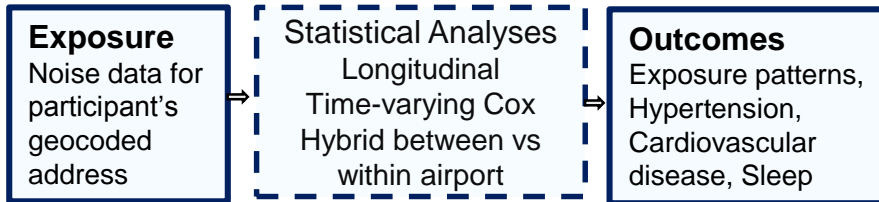
Project Benefits:

Contribution to the body of knowledge of potential health and economic impacts of aircraft noise.
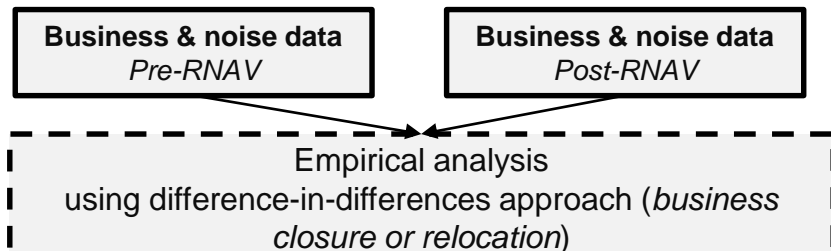
Responsive to Section 189 of the 2018 FAA Reauthorization.

Research Approach:

Health Impacts

Economic Impacts

Major Accomplishments (to date):

1. Submitted papers to journals for publication on sociodemographic patterns of noise exposure and noise and potential risk of hypertension.
2. Submitted abstracts to international conferences on noise and potential sleep and hypertension effects.
3. Acquired business data, mapped business changes for 8 airports, and ran initial analysis for 1 airport.

Future Work / Schedule:

1. Continue analysis on noise and sleep markers – 9/2021
2. Continue analysis on noise and CVD – 12/2021
3. Complete analysis of noise patterns – 12/2021
4. Roll-out economic assessment to a set of airports and run cross-comparisons – 12/2021

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Objective:

To evaluate the relationship between aircraft noise exposure and health including hypertension and sleep disturbance in existing health cohorts (Health Impacts)

Project Benefits:

Addresses gap of limited health and noise studies in the U.S., important for policy models

Overall, contributes to the body of knowledge of potential health impacts of aircraft noise.

Responsive to Section 189 of the 2018 FAA Reauthorization.

Research Approach:

Exposure

Noise contours for 90 airports for 1995-2015 in 5 years interval; metrics day-night noise level (DNL) and nighttime sound level (Lnight)

Cohorts:

Nurses' Health Study (NHS) and NHS II

Study Areas

1. Sociodemographic patterns of noise
2. Associations between noise and hypertension and noise and cardiovascular disease (CVD)
3. Associations between noise and sleep markers

Major Accomplishments (to date):

1. Submitted papers to journals for publication
   a. Sociodemographic patterns of exposure to civil aircraft noise in the United States
   b. Long-term aircraft noise exposure and risk of hypertension in the Nurses' Health Studies
2. Submitted abstracts to international conferences
   a. Associations between nighttime aircraft noise exposure and insufficient sleep in the US-based prospective Nurses' Health Study cohort
   b. Long-term aircraft noise exposure and incident hypertension in national US cohort studies

Future Work / Schedule:

1. Continue analysis on noise and sleep markers – 9/2021
2. Continue analysis on noise and CVD – 12/2021
3. Complete analysis of noise patterns – 12/2021

Health Impacts – Project Outline

Spring 2021

1 **Finalize Phase I CVD Analysis** (Ascent 3)
- Analysis of sociodemographic patterning of noise exposures
- Analysis of trends of aircraft noise exposures
- Analysis of aircraft noise (DNL and Lnight) and hypertension

2 **Perform CVD Phase II Analysis** (Ascent 3)
- Analytical approaches and analysis of relationship of aircraft noise and CVD
- Analytical approaches and analysis of relationship of additional metrics of aircraft noise and health outcomes.

+

3 **Develop Analytical Approach & Sleep Analysis** (Section 189)
- Assessment of potential approaches for analysis and appropriateness of sleep quality data.
- Analysis of annual average aircraft noise exposure with general sleep length and quality (NHS).
- Explore analysis of living under flight paths with sleep disturbance (WHISPER).

Spring 2022

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Health Impact Results-Sociodemographic Patterns of Noise

Status:

- Completed analysis of sociodemographic patterns of noise
- Submitted manuscript for FAA review and for publication

Highlights:

- Compared exposure of U.S. Census block groups by race/ethnicity, education, and income at three noise thresholds (45 dB, 55 dB, 65 dB).   *

- Block groups with higher Hispanic population and proportion of residents with ≤ high school education had higher odds of noise exposure.

In progress:

- Analysis of trends in noise exposure over time
- Analysis of noise exposure and segregation and dissimilarity

Health Impact Results-Hypertension

Status:

- Completed analysis on noise and incident hypertension
- Submitted manuscript for Harvard Channing/NHS and FAA reviews and to peer-reviewed journal

Highlights:

- Examined associations between aircraft DNL and incident hypertension in NHS and NHS II.   *

- In combined models using a 55 dB DNL cut-point, participants in NHS and NHS II exposed to levels ≥55 dB DNL had an 8% increased risk of hypertension when compared to participants exposed to aircraft noise at levels <55 dB DNL, with a 95% confidence interval between -2% and 18%.

- Relationship between noise and hypertension in these cohorts was not affected by additional control for particulate matter air pollution.

Health Impact Results-Sociodemographic Patterns of Noise

Status:

- Analyzing noise and sleep duration and sleep quality

Highlights:

- Investigated associations between nighttime noise and insufficient sleep in NHS.
- In multivariable-adjusted longitudinal models those in block groups exposed to nighttime aircraft noise ≥45 dB had higher odds of insufficient sleep compared with those not exposed.

*

Next Step:

- Investigate noise and sleep markers in NHS II
- Assess measures of sleep quality of in NHS and NHS II and develop analysis plan

ASCENT Project 3 (MIT subaward)

ASCENT
AVIATION SUSTAINABILITY CENTER

Cardiovascular Disease and Aircraft Noise Exposure –
Impacts of Noise on Businesses

Massachusetts Institute of Technology

PI: *R. John Hansman*

PM: *Donald Scata & Sean Doyle*

Objective:
To conduct an empirical assessment of the **economic impacts of aircraft noise on businesses located underneath flight paths** at selected U.S. airports, incl. the trade-off between impacts on businesses

Project Benefits:
1. Empirical assessment of the impacts of aircraft noise on businesses
2. Identification of most affected communities, anticipate consequences of future procedural changes

Research Approach:

Natural experiment: flight procedures changed
→ ± population noise exposure
→ possible business closure & relocation

- **Business data** *Pre-RNAV*
- **Business data** *Post-RNAV*
- **Noise contours** *Pre-RNAV*
- **Noise contours** *Post-RNAV*

Empirical analysis using difference-in-differences approach

- Geospatial analysis
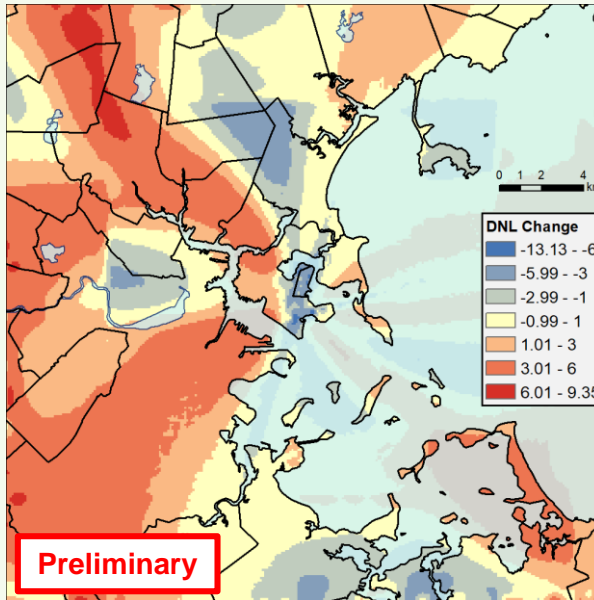- Treatment group analysis
- …

Major Accomplishments (to date):
I. Completed data acquisition, organization and cleaning for business locations across all U.S. states
II. Mapped business changes during 2010s for eight major U.S. airports
III. Ran first data analyses and data visualization for Logan

Future Work / Schedule:
- Apply methodologies → Roll-out economic assessment to a set of airports in the U.S. (Boston, Chicago, etc.)
- Cross-comparison between multiple metropolitan areas and economic sectors (e.g. retail)
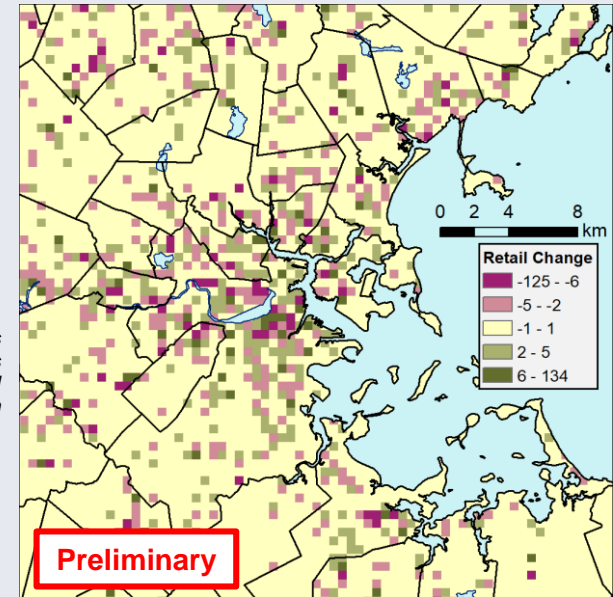
Geospatial Analysis: Boston Logan

DNL Difference (post-RNAV – pre RNAV)

DNL Change
- -13.13 - -6
- -5.99 - -3
- -2.99 - -1
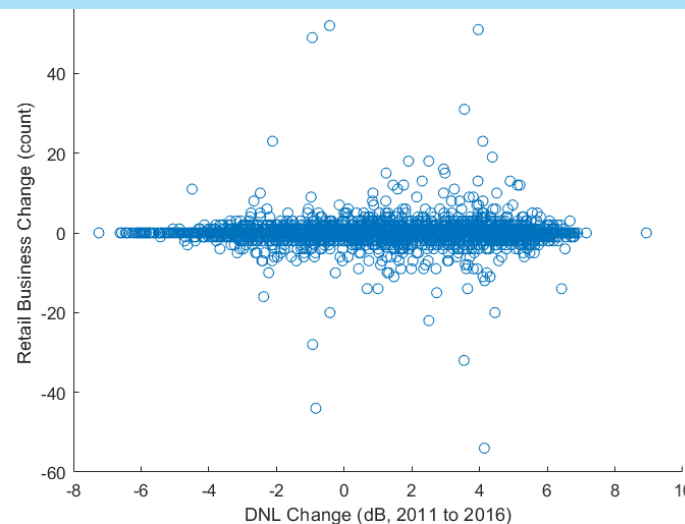- -0.99 - 1
- 1.01 - 3
- 3.01 - 6
- 6.01 - 9.35

Preliminary

Business Count Difference (post-RNAV – pre RNAV)

Gridded at 500m, decreases (purple) and increases (green) in counts of retail businesses, in the Boston area.

Retail Change
- -125 - -6
- -5 - -2
- -1 - 1
- 2 - 5
- 6 - 134

Preliminary

Scatter plot of DNL difference vs. business count difference, *by grid cell, retail businesses only*

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Exploratory analysis of differentiated noise impact changes: Boston Logan
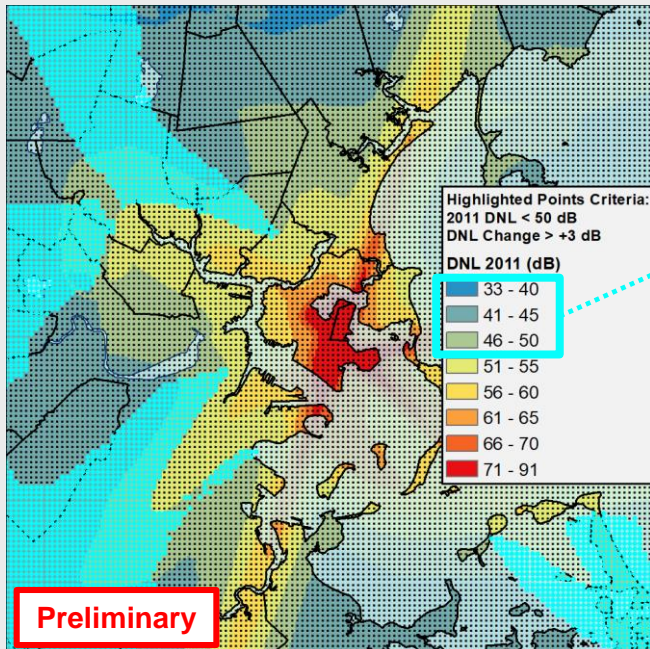
Hypothesis:
Changes in communities that were previously relatively quiet may be more amplified

Analysis:
Create different treatment groups using two criteria:
- Pre-RNAV noise exposure
- Change in noise exposure (pre-RNAV vs. RNAV)

Identification of areas formerly <50dB with DNL change > +3dB

Highlighted Points Criteria:
2011 DNL < 50 dB
DNL Change > +3 dB

DNL 2011 (dB)
- 33 - 40
- 41 - 45
- 46 - 50
- 51 - 55
- 56 - 60
- 61 - 65
- 66 - 70
- 71 - 91

Preliminary

Identification of differentiated treatment groups for Boston Logan Airport

1000m Resolution: 2011 DNL vs Change in Noise (2011 to 2016)

Low original DNL — Increase to DNL

High original DNL — Increase to DNL

Non-treatment group: low change to DNL

Low original DNL — Decrease to DNL

High original DNL — Decrease to DNL

Change in DNL (dB) vs Original 2011 DNL (dB)