# ASCENT 38
# Rotorcraft Noise Abatement Procedures Development

## Motivation and Objectives

### Motivation

- Rotorcraft noise is becoming an increasingly larger issue.
- HAI's "Fly Neighborly Guide" helpful for community noise, but since its publication, new rotorcraft and operations have been developed.
- In ASCENT 6 and ASCENT 38, a physics-based noise prediction tool was developed and validated with flight test data. This tool was also demonstrated to be able improvements from flight procedures and vehicle design changes. to predict potential
- The need for detailed and specific noise abatement procedures are addressed in this task.

### Objectives

- Utilize computational and analytical modeling to develop noise abatement procedures for various helicopters and various phases of flight.
- Determine if it is feasible to develop noise abatement procedures for categories of helicopters.

## Aircraft for Study

- Robinson Helicopters: R44 and R66 (similar size, but R44 has piston engine, while R66 has turbine engine and different main rotor).


- Bell Helicopter Textron, Inc.: 206L and 407 (similar weight and size, but 2-bladed vs 4-bladed main rotor; 407 is newer generation).


- Airbus Helicopter: AS 350 and EC 130 (different anti-torque technology, tail rotor vs. Fenestron; 3-bladed main rotors).


## Summary

### Approach

1. **Selection of helicopters to be used for noise abatement procedures**
   - Gross take-off weight
   - Number of main rotor blades
   - Regular vs quiet tail rotor
   - Rotor technology level or rotor "generation"
2. **Analyze noise abatement procedures for each of the selected helicopters**
   - Model helicopters for noise prediction
   - Identify or develop noise abatement procedures
3. **Evaluate whether unique noise abatement procedures should be developed for each category**
   - Determine whether abatement procedures work for different helicopter categories
   - Consider if a category is really representative of individual helicopters in the category
4. **Model noise abatement procedures to demonstrate their advantages**
5. **Analyze noise abatement procedures in support of FAA/NASA flight test program**
   - Detailed analysis of abatement procedures

### Accomplishments

- Evaluate noise for flight test aircraft for flight test matrix
  - Several helicopter models have been set up
  - Computed several noise metrics for these aircraft for several flight conditions
  - Provided predicted noise hemisphere data to Volpe for procedure development and evaluation
- Preliminary comparisons of the SEL contours for all helicopters have been carried out
  - 80 kts, 6 deg descent flight
  - 80 kts, level flight
  - 80 kts, 3 deg flight condition
- Developed broadband wall/ground reflection model in PSU-WOPWOP after comparing the predictions with flight test data

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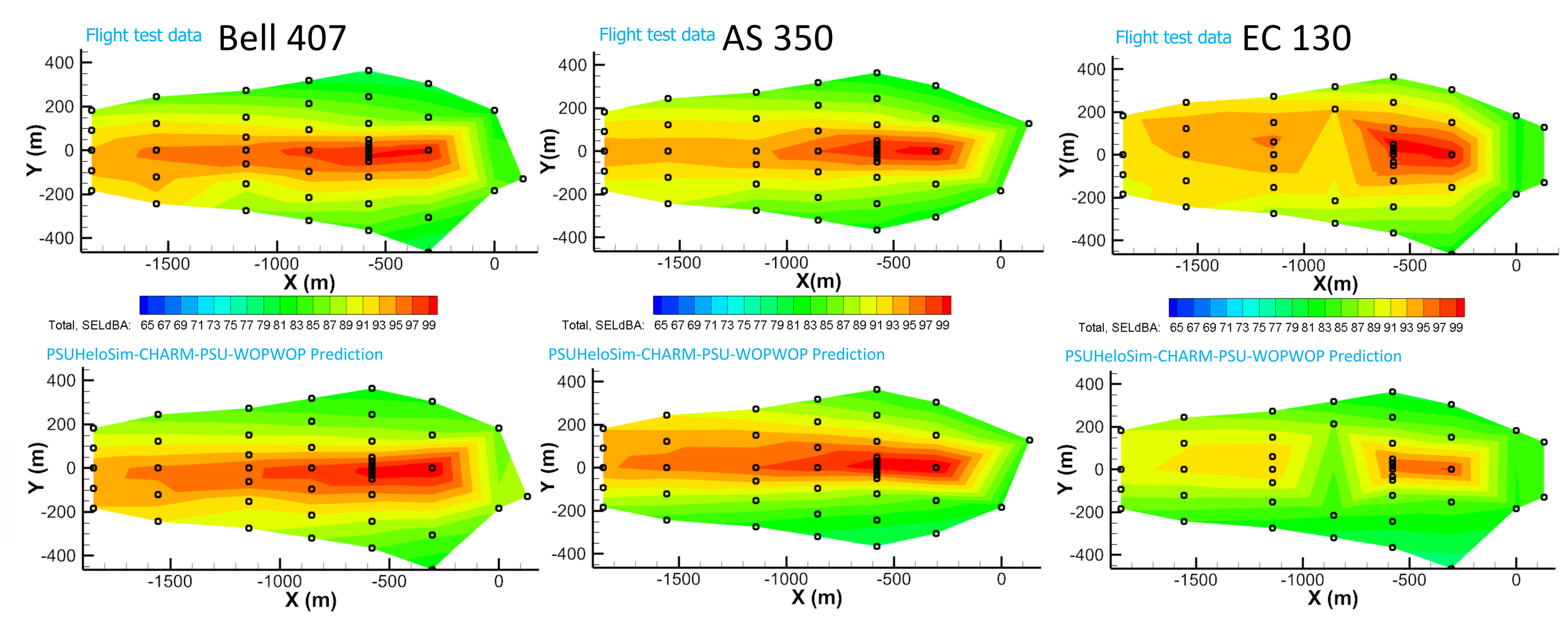
October 09-10, 2018

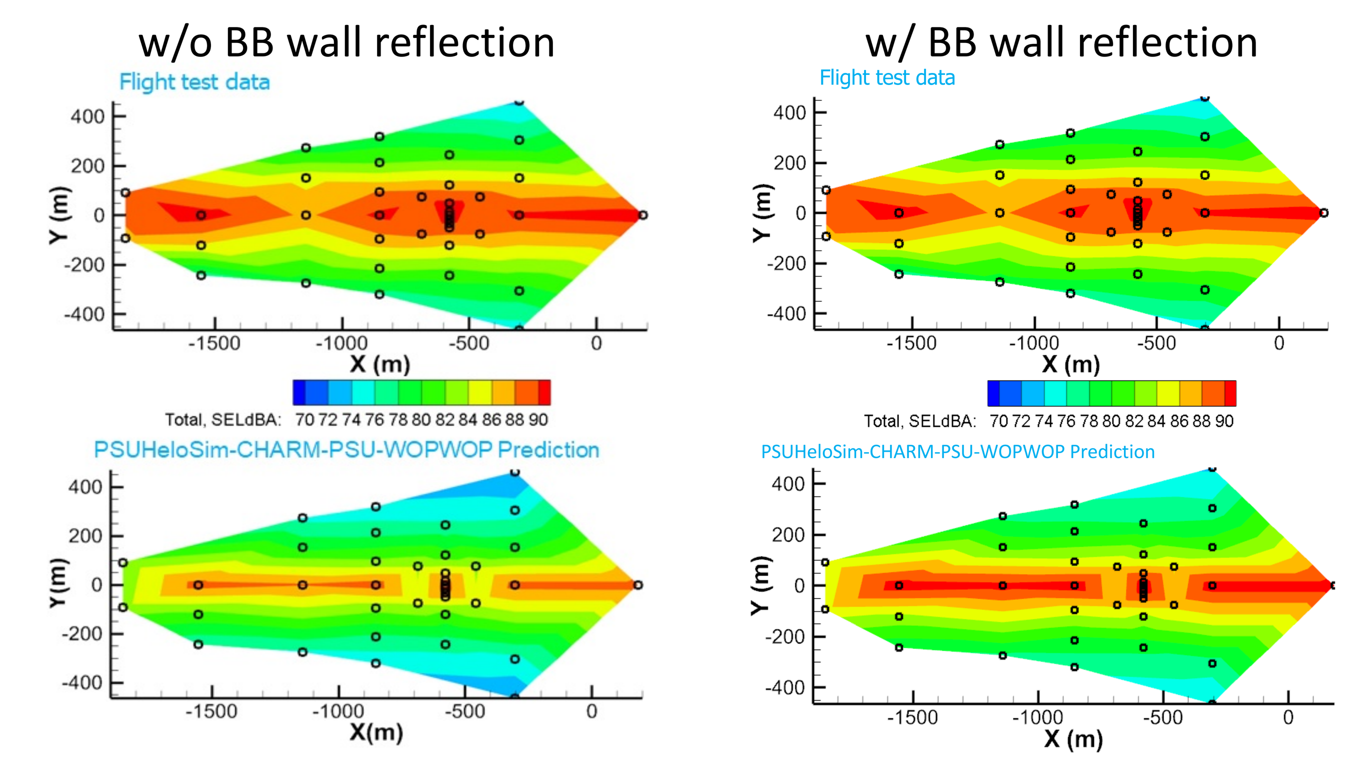
## Results and Discussion

### Validation of noise prediction system

- 6 deg steady descent: 80 kts, comparison between the predicted results and flight test data (results include broadband wall reflection)




- R66 level flight: 80 kts, comparison between the predicted results and flight test data




## Conclusions and Next Steps

- Predicted SEL levels and directivity agree well with flight test data
- Issues with the predictions:
  - Transient effects of the flight test - not included
  - Aircraft roll - not currently included in the predictions
  - EC130 Fenestron not modelled - probably explains the under prediction
- In future, more cases with transient flight conditions will be compared with the flight test data and the prediction will include the time dependent nature of the flight
- Validation of the prediction model will provide more confidence during the design of noise abatement procedures

This work was funded by the US Federal Aviation Administration (FAA) Office of Environment and Energy as a part of ASCENT Project 38 under FAA Award Number: 13-C-AJFE-PSU-38. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the FAA or other ASCENT Sponsors. The R-44 and R-66 helicopter data was collected in Phase I of the NASA/FAA/Army joint test conducted in September 2017 at Eglin AFB, and the Airbus AS350B3, Airbus EC130B4, Bell 206L3, and Bell 407 helicopter data was collected in Phase II of the NASA/FAA/Army joint test conducted in October 2017 at Amedee AAF.