

Noise Power Distance Re-evaluation

Project 43

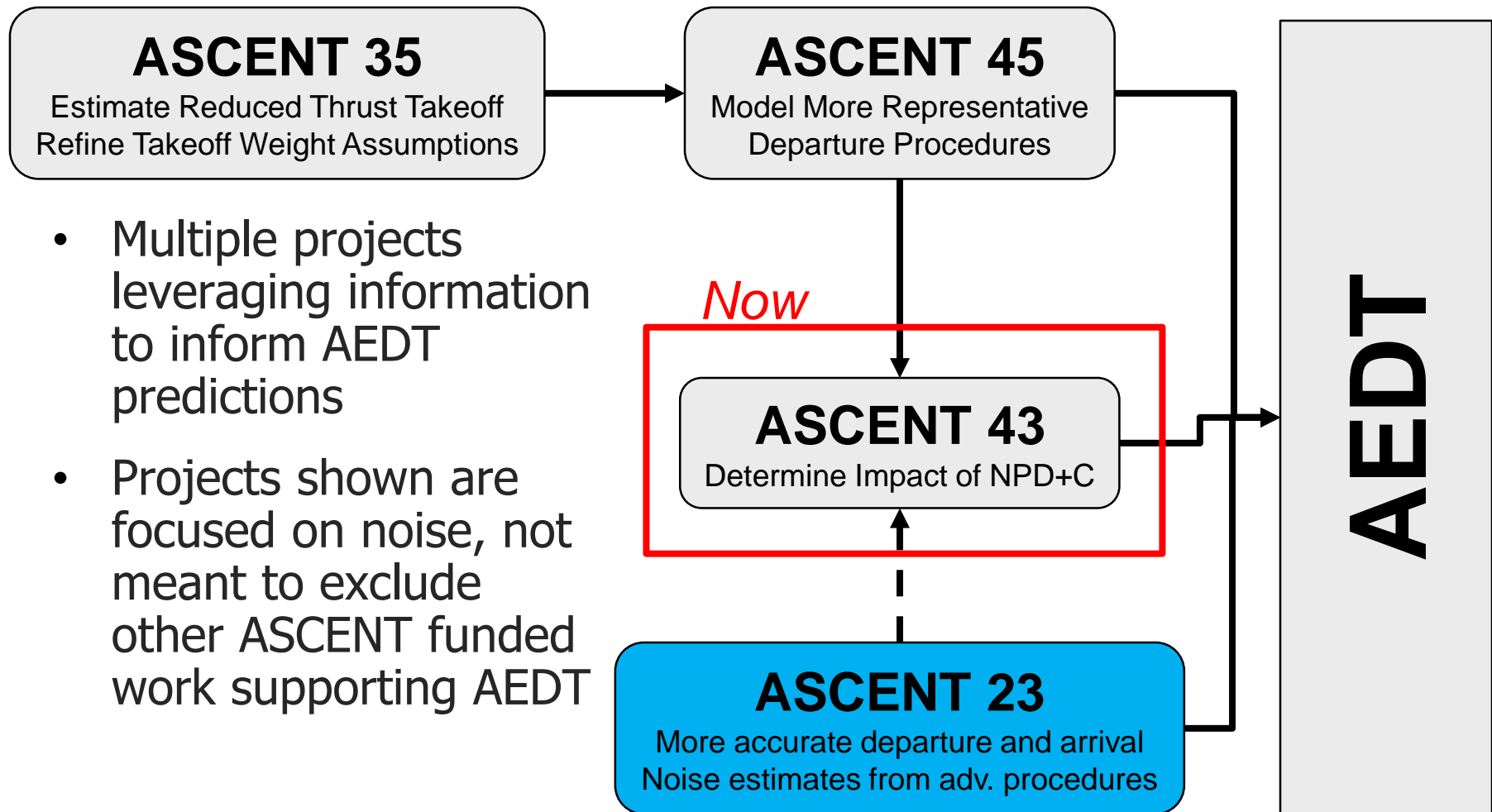
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Project manager: Bao Tong, Bill He (FAA)

April 18 & 19, 2017
Alexandria, VA

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How Does It All Fit Together?



*MIT

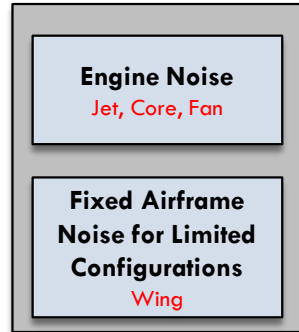
Project 43 Goals



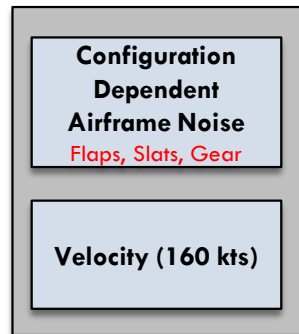
- Goals
 - Understand the sensitivity of including aircraft configuration changes and speed in NPDs on resulting noise contours
 - Provide physics-based recommendation on format of NPD + Configuration (NPD+C) curves for use in AEDT
- Project Impact
 - Quantify improvement to noise contour prediction from including aircraft configuration information
- Objectives
 - Study representative fleet mixes and aircraft sizes
 - Validation against available measurement data, where available
 - Maintain compatibility with existing NPD (integrated model) approach

NPD Modeling Overview

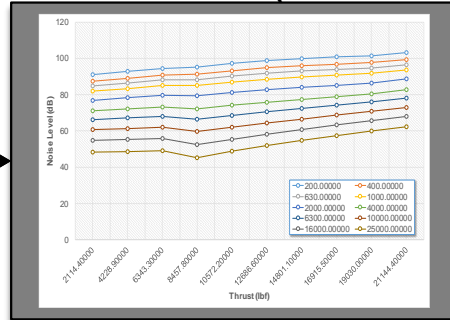
Current Data Within NPD



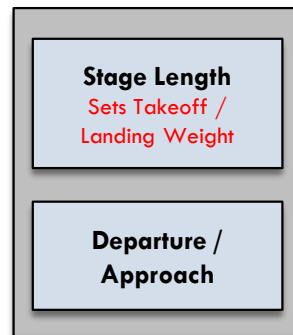
Assumed Constant



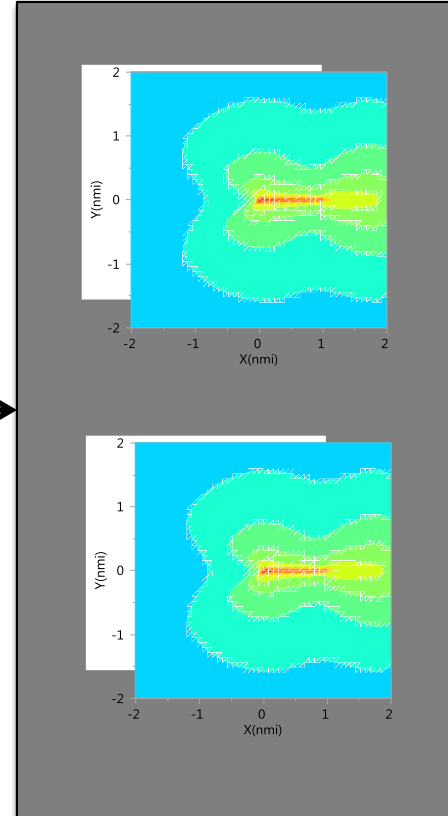
NPD Generation (Per Vehicle)



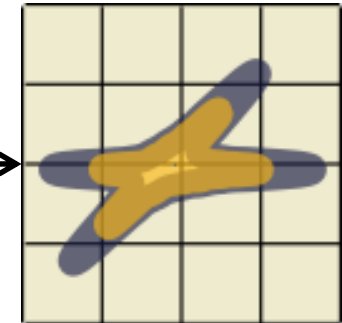
Aircraft Mission



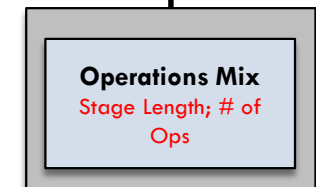
SEL Generation (Per Stage Length)



DNL Contour

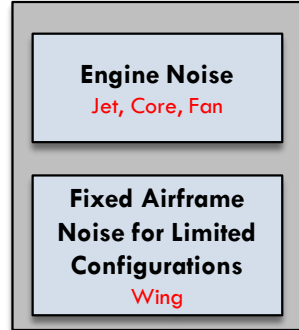


Fleet Mix

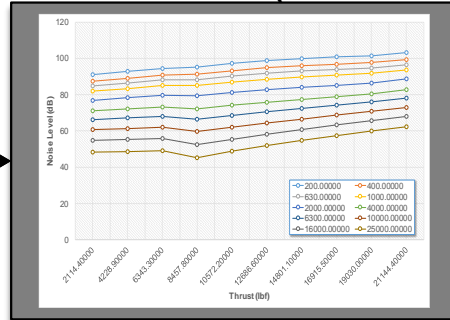


NPD Modeling Overview

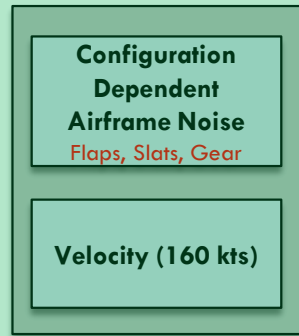
Current Data Within NPD



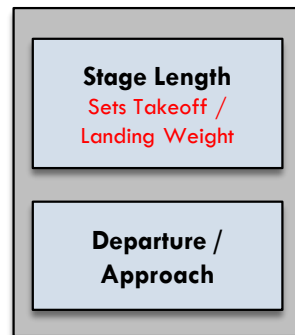
NPD Generation (Per Vehicle)



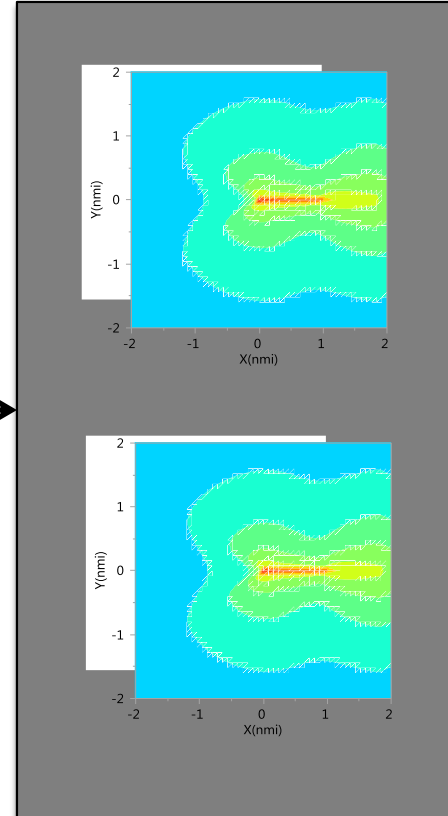
Assumed Constant



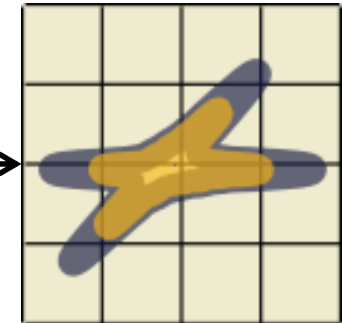
Aircraft Mission



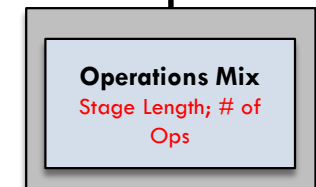
SEL Generation (Per Stage Length)



DNL Contour

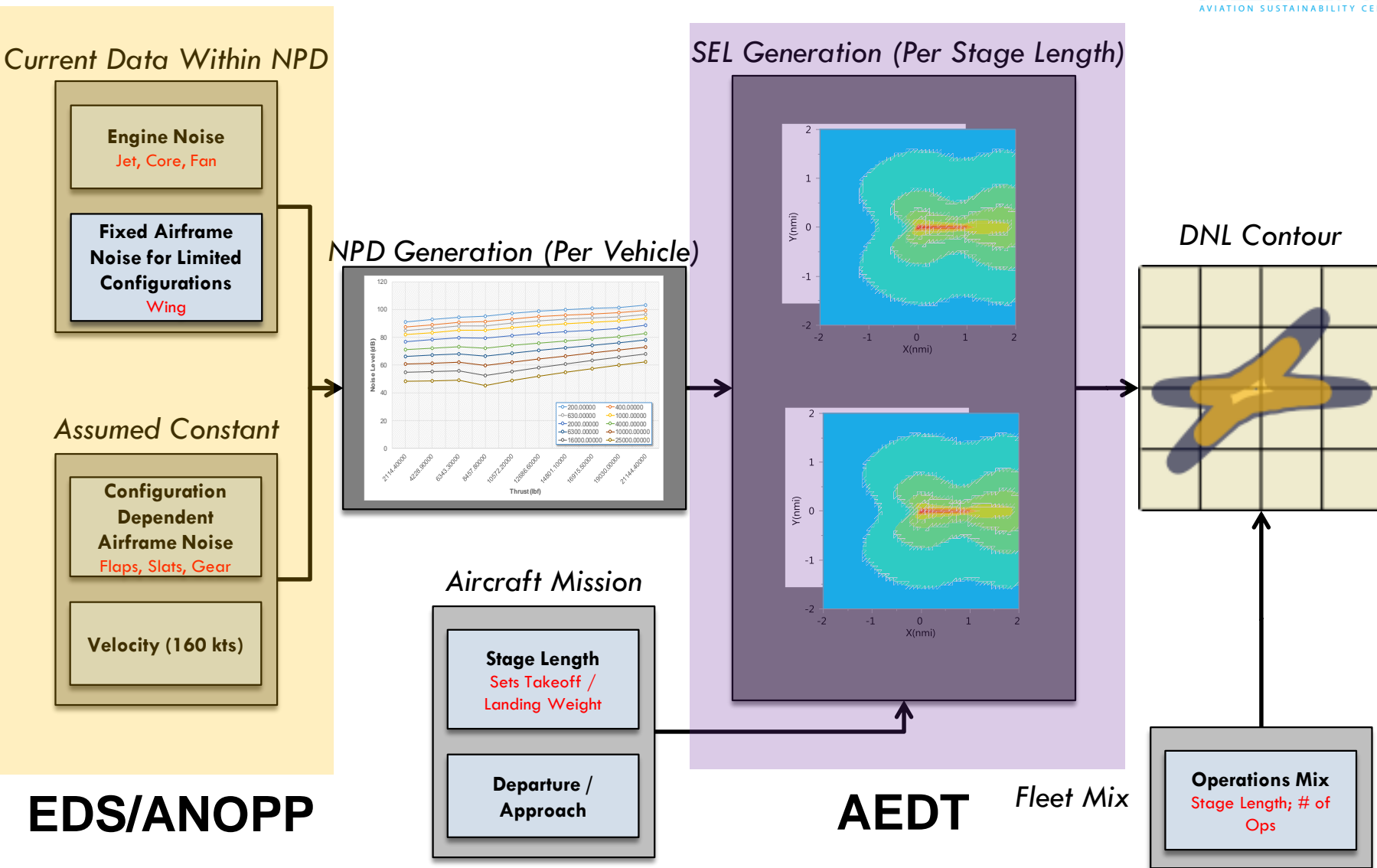


Fleet Mix



ASCENT 43 Focus

Tool Selection



Schedule and Status

Task 1

Vehicle Level Sensitivity Study on NPD Curve Generation

- Determine number of additional modeling parameters needed
- Examine # of additional increments vs. accuracy for speed and configuration
- Use EDS to generate NPD+C curves for representative aircraft size classes

Task 2

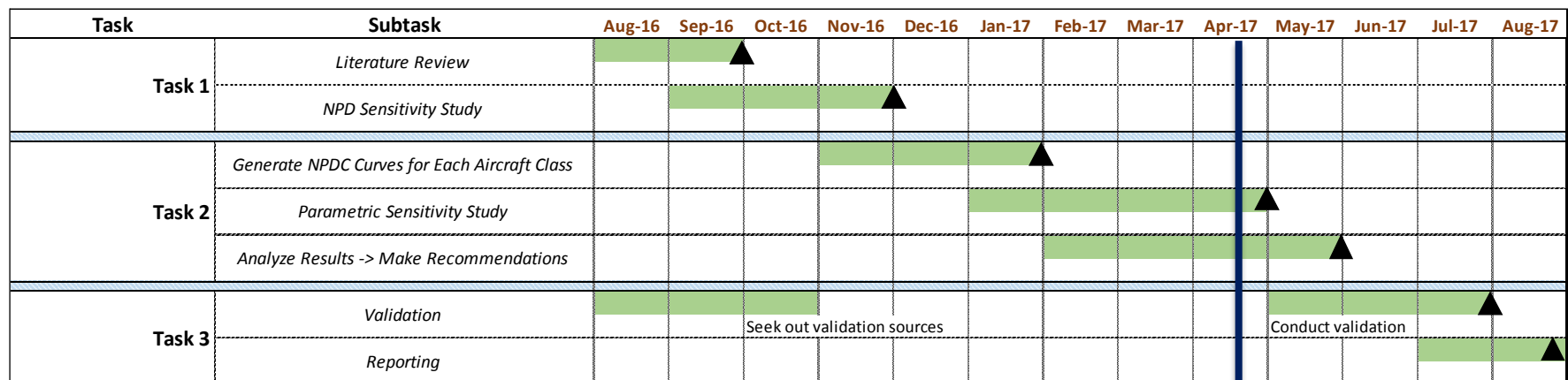
Fleet Level Sensitivity

- Modify AEDT source to accept NPD+C
- Parametric sensitivity study of fleet noise including speed, ambient conditions, vehicle configurations, etc.

Task 3

Validation of Proposed Approach

- Compare against available measurements
- May include: Wyle, ASCENT 23, FDR data, certification data



Task 1: Generating NPD+C

- Use ANOPP to generate NPDs for each vehicle with varying configurations and speeds
- ANOPP enables prediction of impact of **speed** on **source noise**
 - Speed/duration corrections within AEDT do not account for changes in the source noise
 - Can independently vary speed and low speed configuration within ANOPP regardless of vehicle aerodynamics
 - NPD generated using steady, level flyovers, as consistent as possible with ICAO Doc-9501

Input Parameter	Flap Deflection Angle	Slat Deflection Angle	Landing Gear Config	Speed (knts)
Min	0	0	All DOWN	130
Nominal	15	10	Mix	160
Max	40	40	All UP	190
Increment	5	5	N/A	10

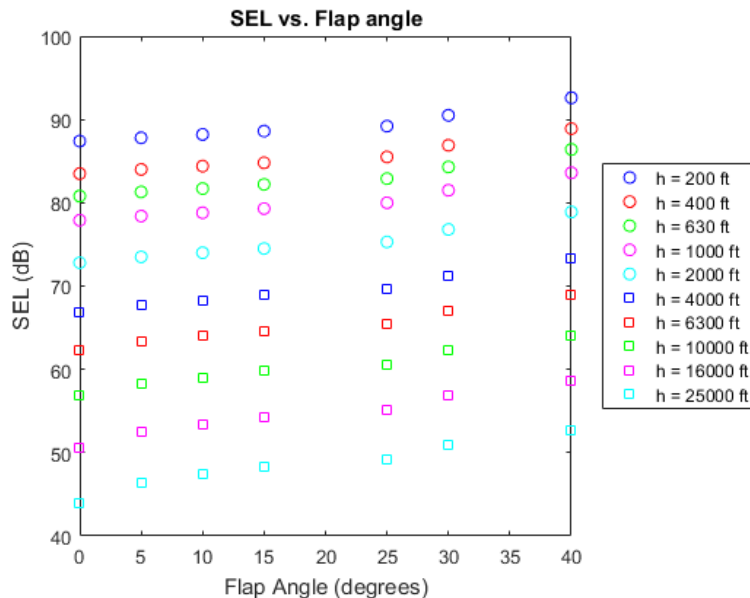


Assume coupled schedule

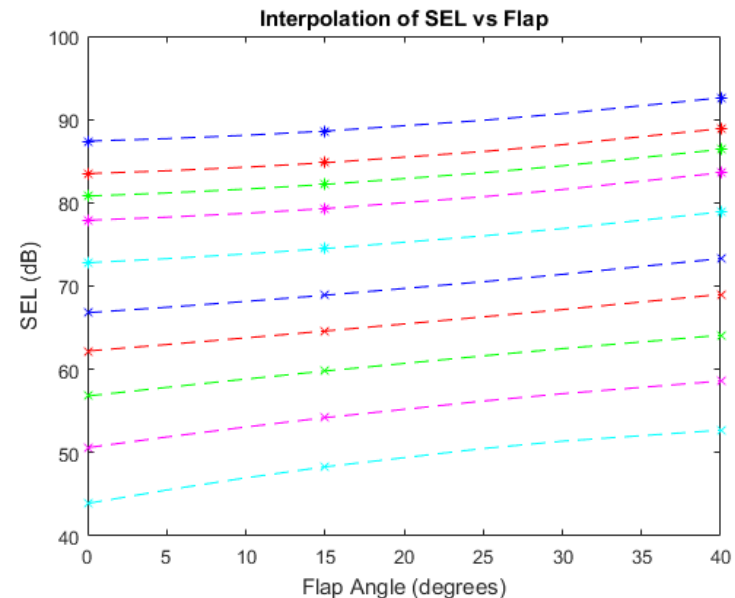
NPD+C Interpolation Study

- Interpolation scheme was fit to the data to predict the noise levels
 - Configurations settings (2 speed, 3 flap/slat, 2 gear)
 - Altitude
 - Thrust
 - Flight speed
- Have successfully generated NPD+C for 50pax – 400 pax passenger seat classes

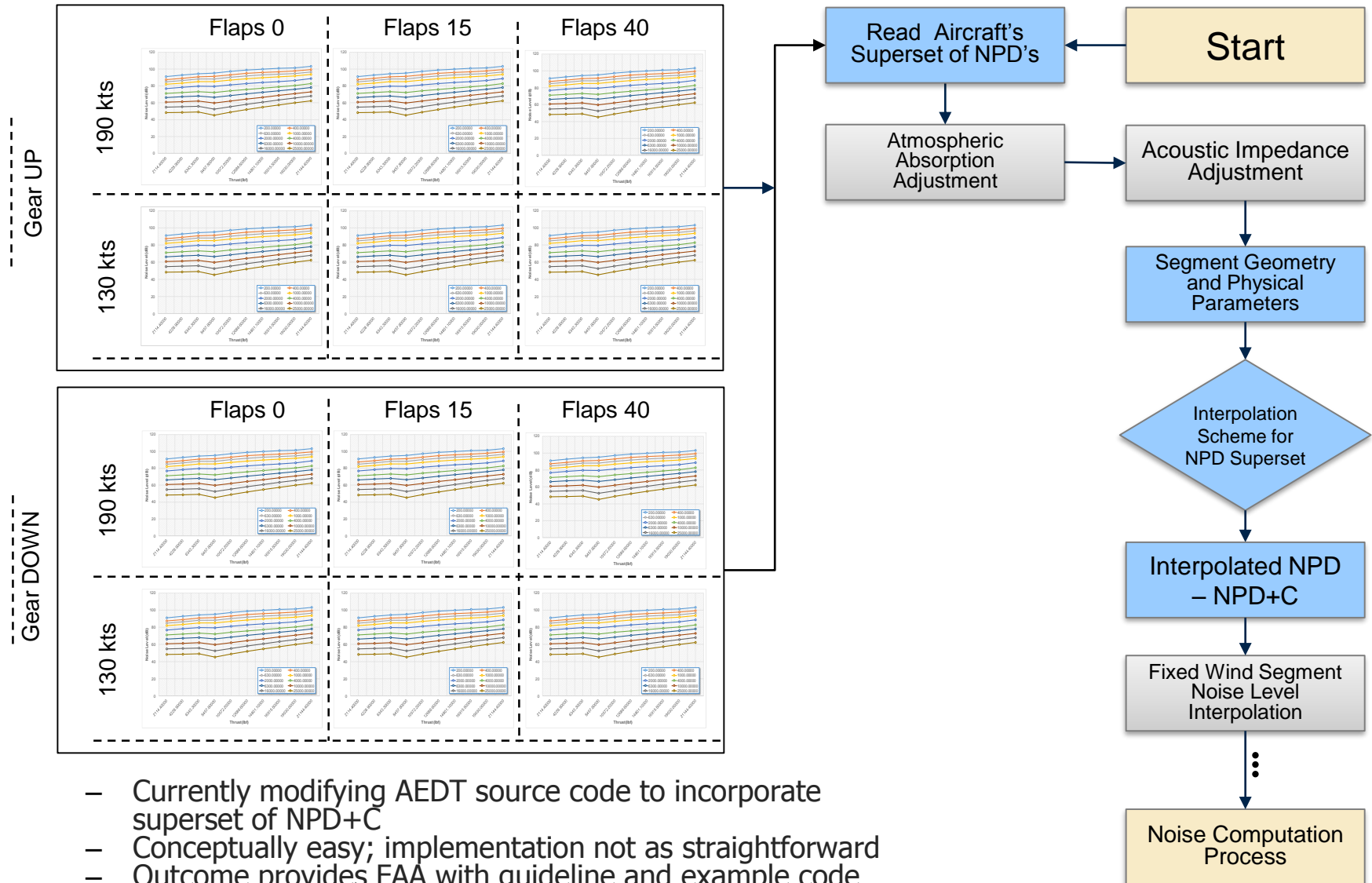
ANOPP Output Data



Interpolation

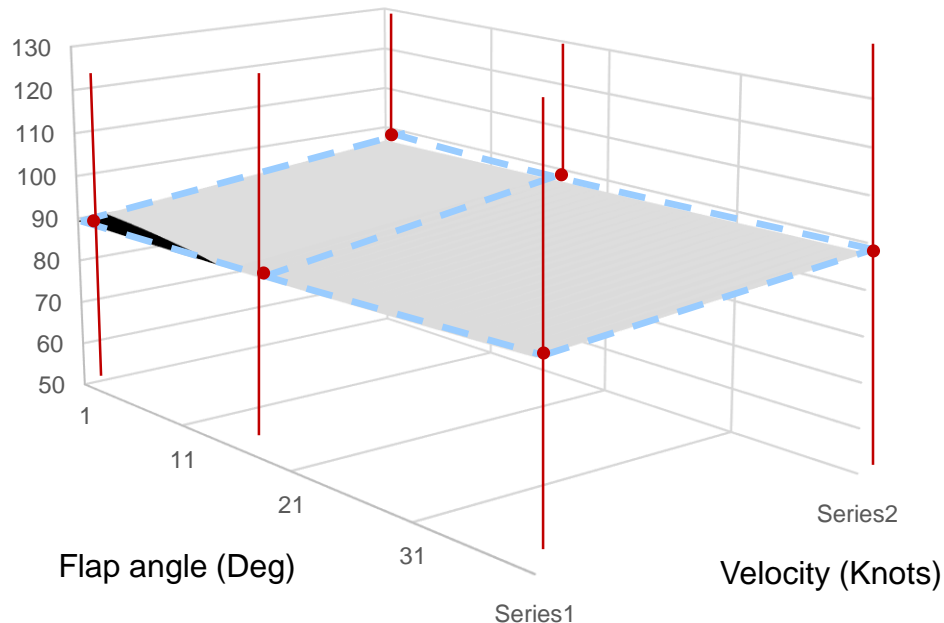


NPD+C AEDT Modeling Changes



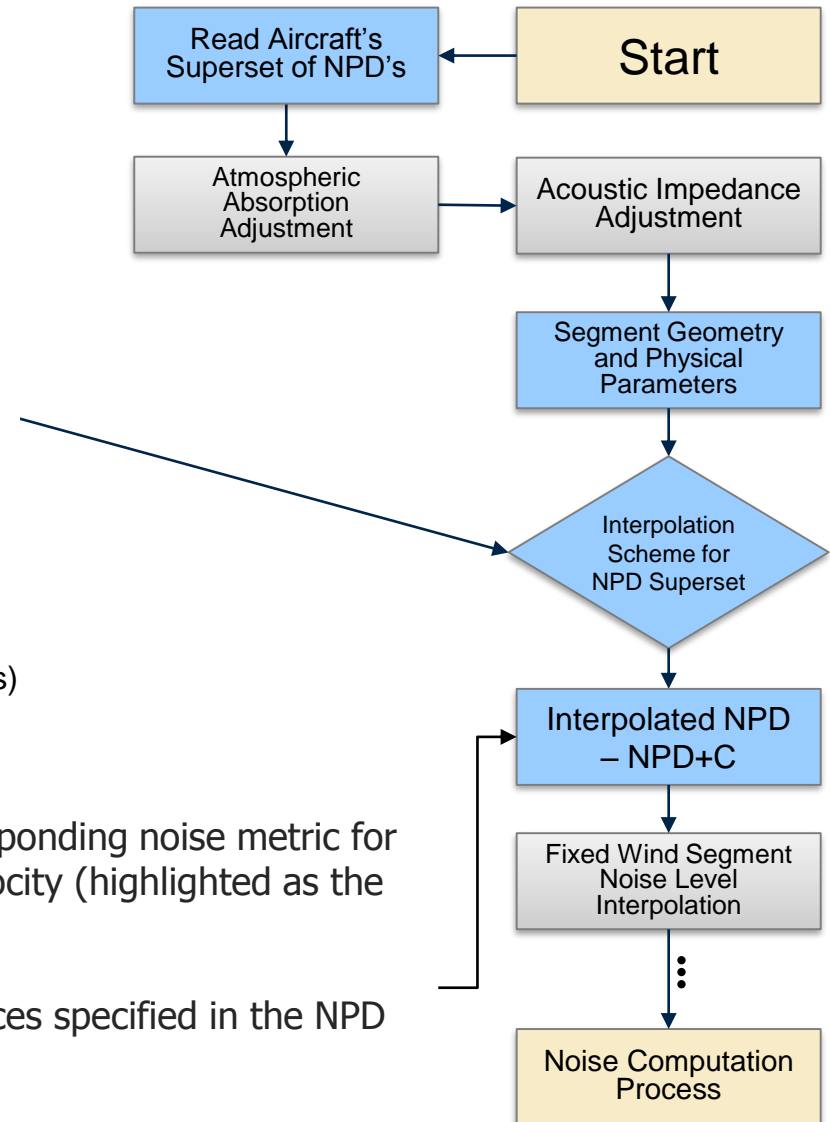
NPD+C Development Process

Thrust setting = 10233 N
Gear setting = Down



Interpolation Scheme

- For a given thrust and gear setting, find the corresponding noise metric for the discrete values of flap angle and reference velocity (highlighted as the six red dots in the SEL surface)
- Interpolate NPDs
- This process is repeated for each of the ten distances specified in the NPD



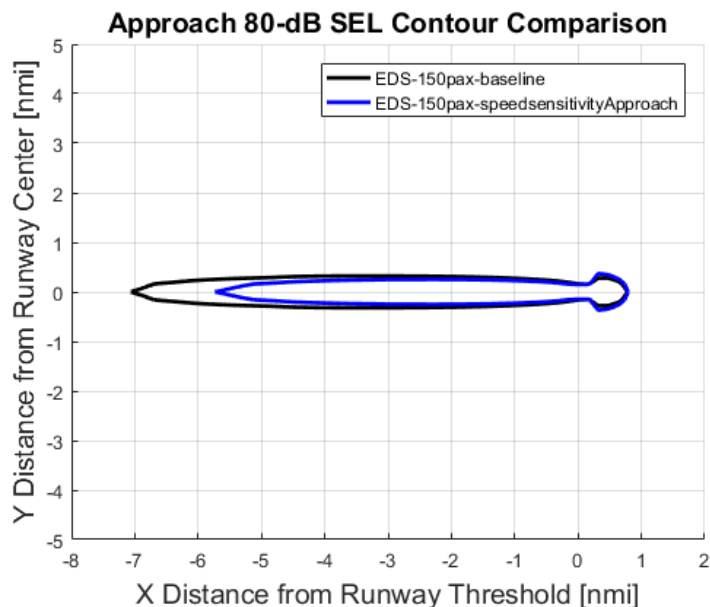
Sensitivity Plan

- Defined sensitivity study to identify most appropriate NPD+C format and data
- Just completed first runs for preliminary assessment

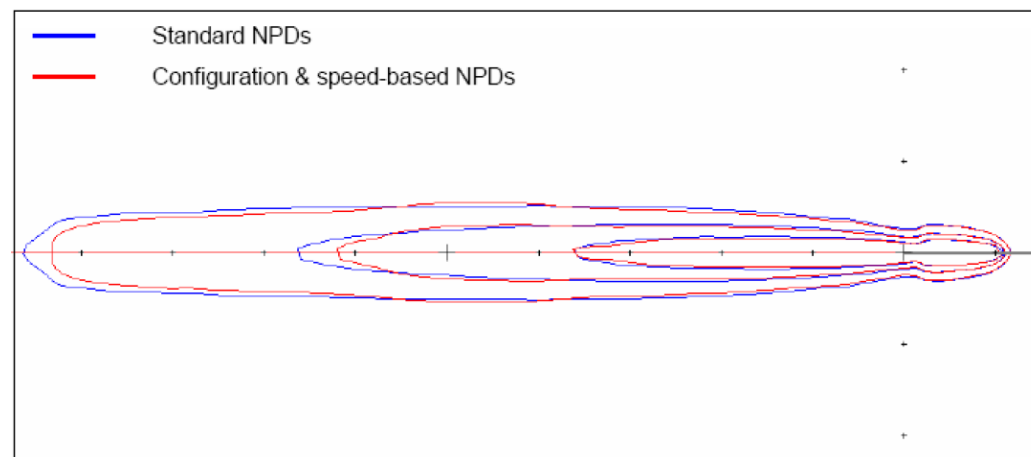
Grouping	Study	Parameters
Baseline	0	Baseline NPD
Main Effects	I.A	Include only speed
	I.B	Include only flaps/slats
	I.C	Include only gear
Cross Terms	II.A	Speed + Gear
	II.B	Speed + Flaps
	II.C	Gear + Flaps
	II.D	Speed + Gear + Flaps
Segment	III.A	Flaps retract with gear
	III.B	Flaps retract after gear
	III.C	NADP 1 & 2
	III.D	<i>Segment Length</i>
	III.E	<i>ANOPP Validation of SEL</i>
Configuration	IV.A	Flaps 1
	IV.B	Flaps 5
	IV.C	Flaps 15

Speed Sensitivity – Approach – 150 Passenger Class

Preliminary ANOPP/AEDT Results



Sourdine II Project (circa 2006)



*EUROCONTROL – Episode 3: D2.4.4-03: Required enhancements of existing assessment noise models to validate SESAR Operational Improvements steps

- Similar studies has been done previously, with different assumptions
 - Sourdine coupled speed to configuration, resulting in NPD's which are specific to aircraft type and assumed performance
 - Plot to the left is 80 dB SEL, whereas plot to right is 55-65 DNL
- Qualitatively, we are seeing similar trends; more analysis and understanding required

PRELIMINARY RESULTS – DO NOT CITE OR QUOTE

Next Steps



- Complete sensitivity study
- Deeper dive into analyzing and understanding results
- Provide recommendations on NPD+C format
 - Must balance additional data required against increased accuracy
 - What additional parameters are required that are not in the current database?

Acknowledgements



- FAA & Volpe for valuable feedback
- Juliet Page for invaluable insight into prior work

Participants

- GT Research Staff:
 - Matt LeVine, Greg Busch, Holger Pfaender, Michelle Kirby
- GT Students:
 - Arturo Santa-Ruiz, Ken Decker