FAA AEDT Updates

Presented to: ASCENT Advisory Committee

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Federal Aviation Administration

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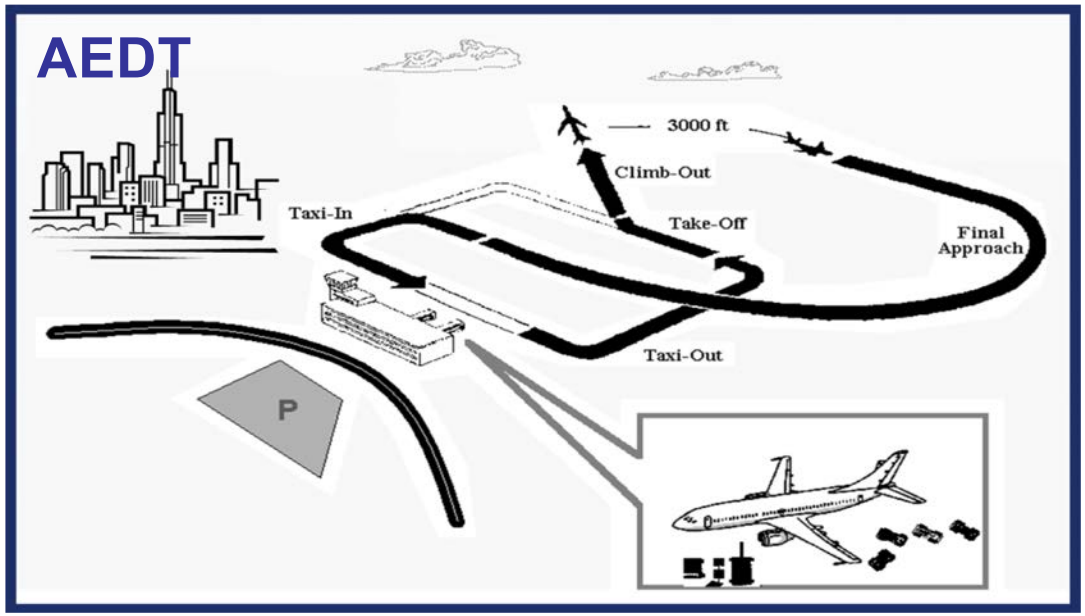
Aviation Environmental Design Tool (AEDT)

Features

- Computes noise, fuel burn, emissions, and air quality
- Able to conduct analyses at airport, regional, national, and global scales



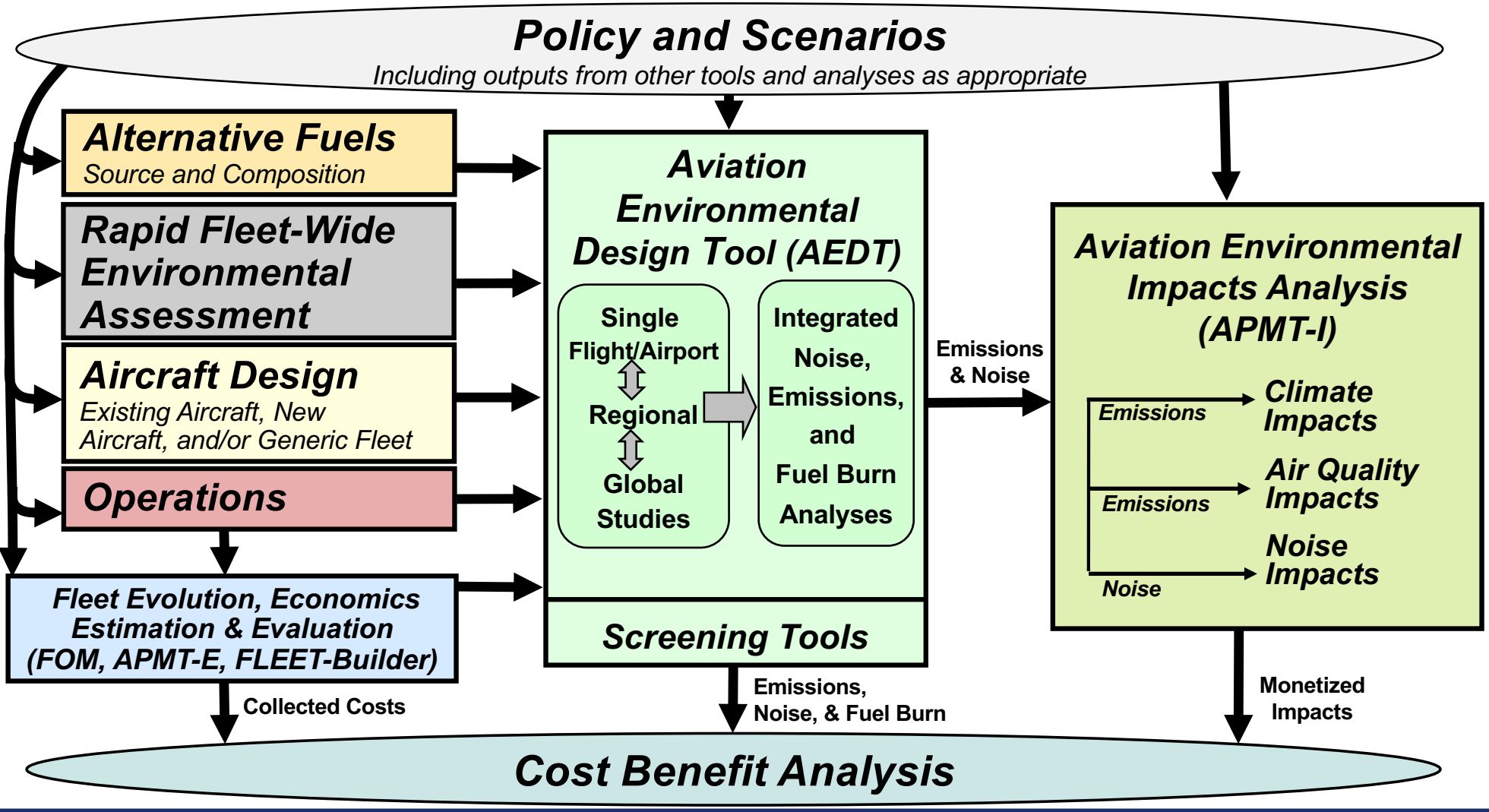
Applications

- Air space and airport design and planning (e.g., National Environmental Policy Act reviews)
- International Civil Aviation Organization (ICAO) Committee on Aviation Environmental Protection (CAEP) analyses
- Assessing benefits from introducing NextGen and new aircraft and engine technologies (e.g., from FAA CLEEN and NASA Programs)

For more information on AEDT or to download it, please visit: https://aedt.faa.gov/

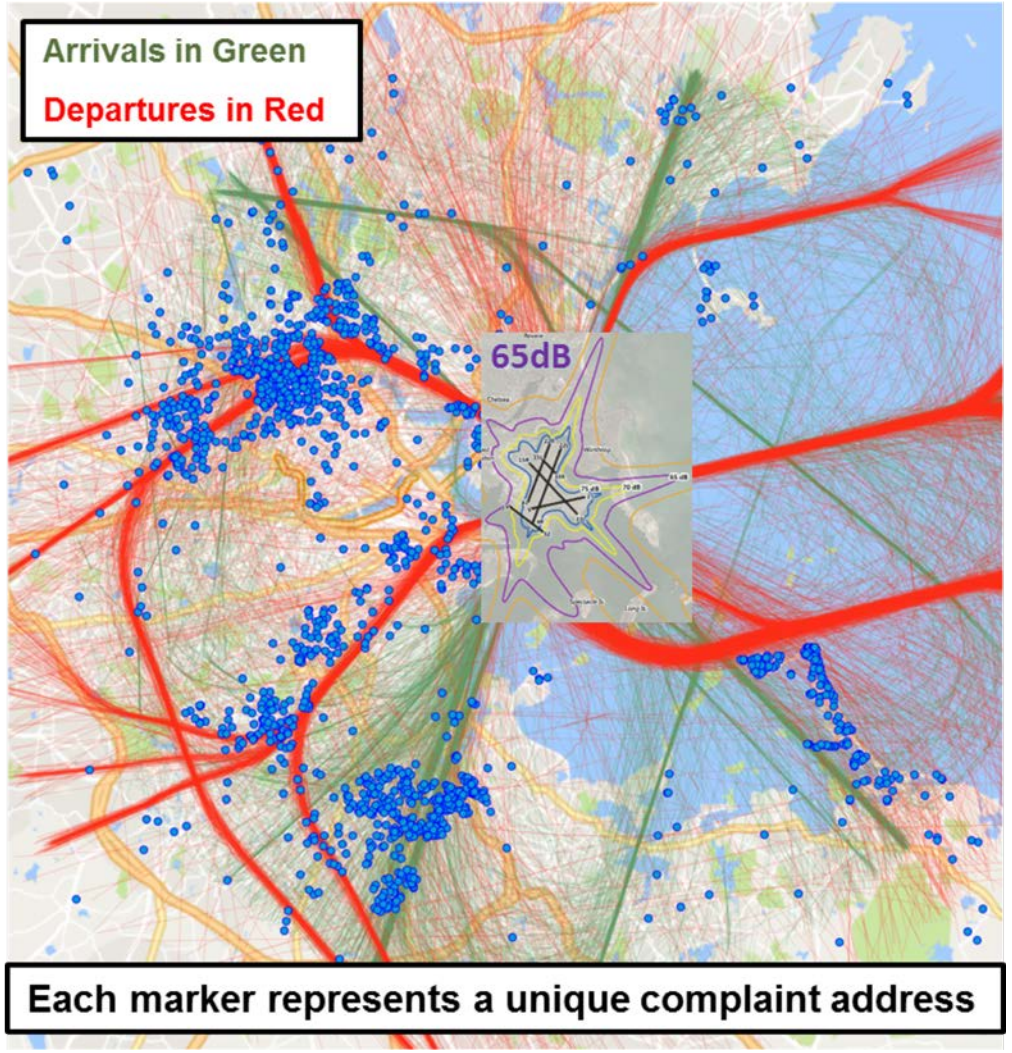
Environmental Tools Suite

Modeling range of solutions and their consequences on fuel use, noise and emissions (basket of measures for CO_2 and balanced approach for noise)



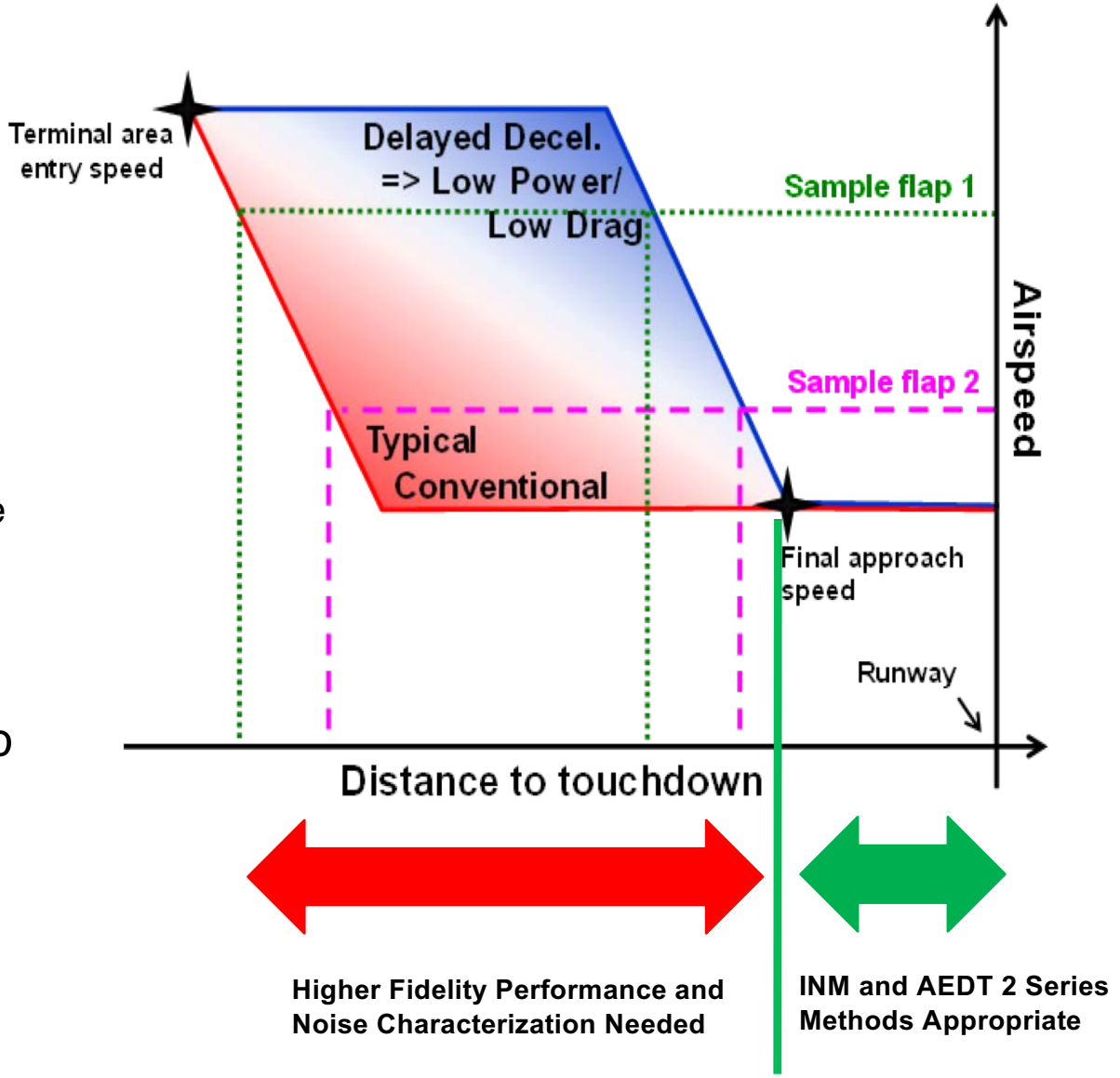
Current Aviation Noise Challenge

- Precision navigation is being implemented to increase the safety and efficiency of the NAS.
- It also leads to a reduction in the overall number of people exposed to noise from aircraft operations.
- However, implementation has been accompanied by increased airport community noise concerns.
- Concepts being evaluated to reduce noise through operational procedures.
  - Route changes
  - Thrust / speed management
  - Vertical profile
  - Introduction of systematic dispersion



Future Direction of Noise and Performance Modeling

- INM/AEDT 2 series assume noise is engine dominant; focus is on departure noise and DNL 65 dB contour.
- Crude accounting of noise effects for different flap/gear settings.
  - As engine noise is reduced, airframe noise becoming important, particularly on approach.
- Higher fidelity performance and noise characterization needed to evaluate advanced operational procedures beyond DNL 65 dB.



Two-Step Development Approach

Current Day - 2022

AEDT 3 Series

High Fidelity Aircraft Performance

- Implementation of BADA4[1]
  - EUROCONTROL model designed for simulation and prediction of aircraft trajectories
  - Cost effective way to provide higher fidelity lift and drag for more detailed procedure modeling in the terminal area

2022 and beyond

AEDT 4 Series

High Fidelity Noise Characterization

- Develop configuration based source data that enables more accurate noise prediction due to aircraft configuration and speed changes
  - Based on ANOPP[2] model

1. BADA4 = Base of Aircraft Data family 4
2. NASA's Aircraft NOise Prediction Program

AEDT Status

- **AEDT 3a completed December 2018**
  - Not for public release; BADA 4 use agreement pending
- **AEDT 3b scheduled for public release in March 2019**
- **Aircraft performance modeling update**
  - BADA4 implementation provides more accurate and unified modeling of aircraft performance for both terminal area and cruise operations
  - Improved aircraft takeoff weight and takeoff thrust modeling to better represent flight operations
  - User-defined profile definition through GUI
- **Aviation emissions dispersion modeling updates in AEDT 3b**
  - AERMOD/AERMET update to latest versions
  - Three-tiered screening approach to NO2 modeling
  - AERMET options update
- **Fleet database updates**
  - Gulfstream G650; Boeing 737- MAX8; Boeing 737-800 Approach; Airbus 320-271Neo, Falcon 900, A350-941

Notes:
1. BADA = Base of Aircraft Data
2. AERMOD: The American Society/Environmental Protection Agncy Regulatory Model
3. AERMET: Meteorological data preprocessor for AERMOD

BADA 4 Challenges

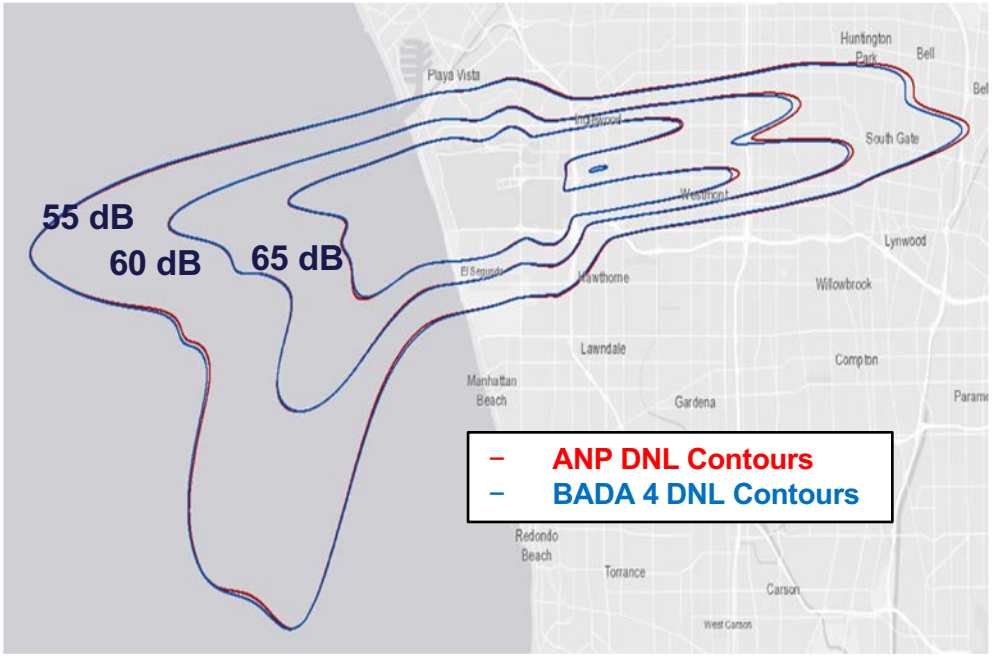
- **Aircraft fleet coverage**
  - BADA 4 terminal area fleet coverage not as extensive as ANP, However good coverage of Air Carrier fleet. ANP still used to supplement fleet database.

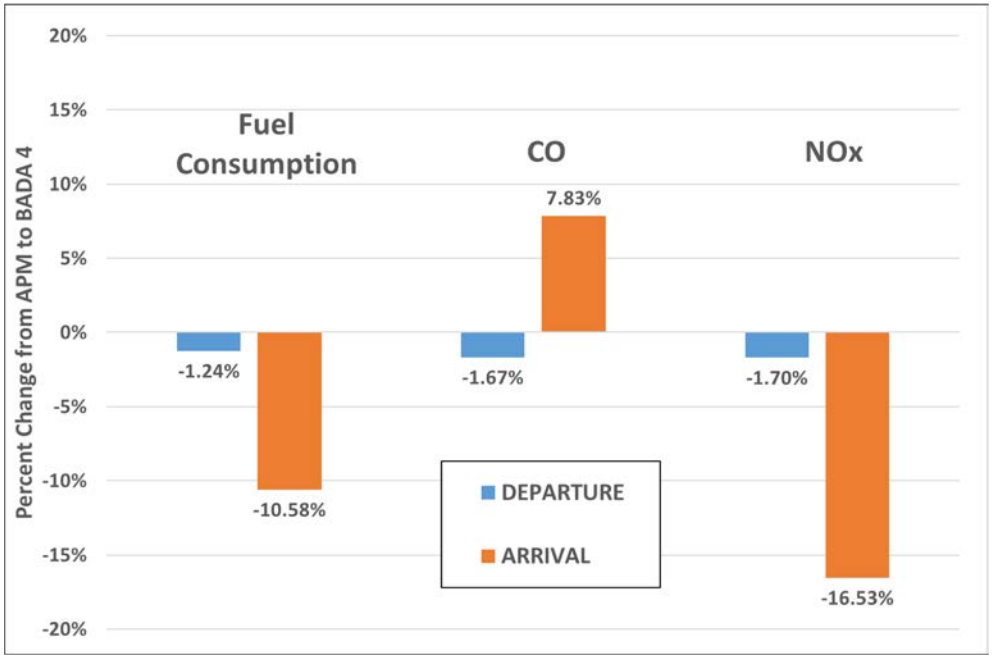
- **Aircraft data gaps**
  - Certain models have incomplete data; some data are estimated
  - Low altitude (below 1500 feet) data not available for some aircraft models
  - No aircraft departure or arrival procedure data
  - Still reliant on ANP database for aircraft data gaps and procedural profiles

- **Maintenance of use agreement**

Airport Level Results

- **BADA 4 performance has small effect on noise**
  - DNL noise contours roughly 2% smaller with BADA 4 on average
- **BADA 4 performance effect on fuel burn varies by fleet mix**
  - Total (departure and arrival) fuel burn below 10K feet roughly ±5% change with BADA 4

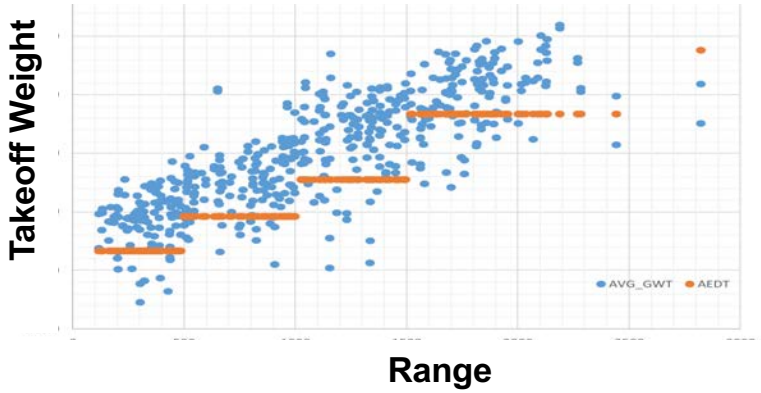


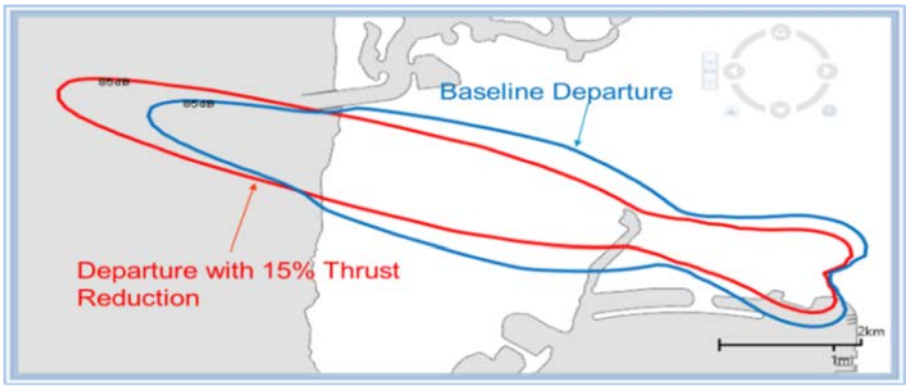


Aircraft Takeoff Weight and Thrust Model

- **Aircraft takeoff weight and thrust are critical parameters in environmental modeling.**
- **Current assumptions based on limited data available.**
  - Payload load factor at 65%
  - Standard departure profiles assumes maximum thrust at takeoff
- **<u>Research:</u> analyzed airline data and recommended options for improvement**
  - ASCENT 35/45

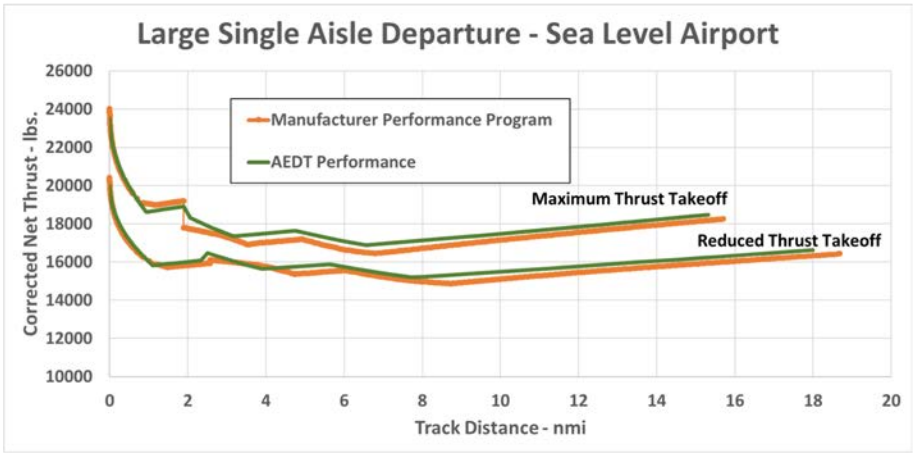
B737-800 AEDT2d Modeled versus Actual Takeoff Weight

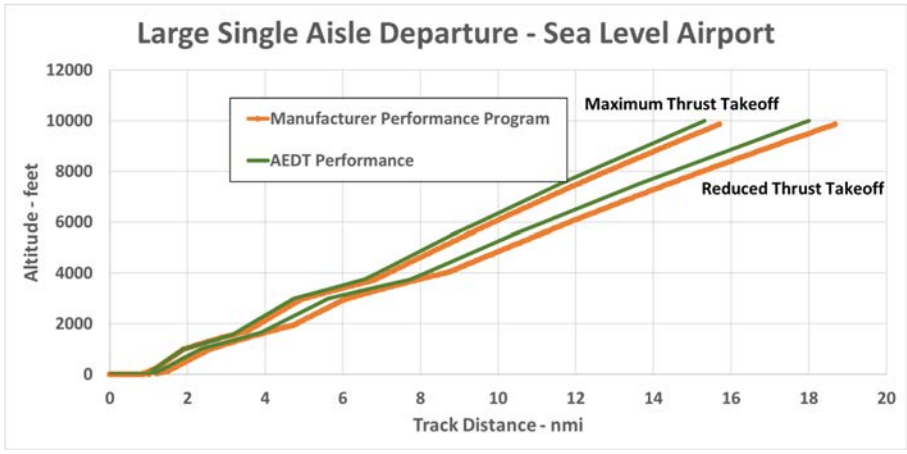


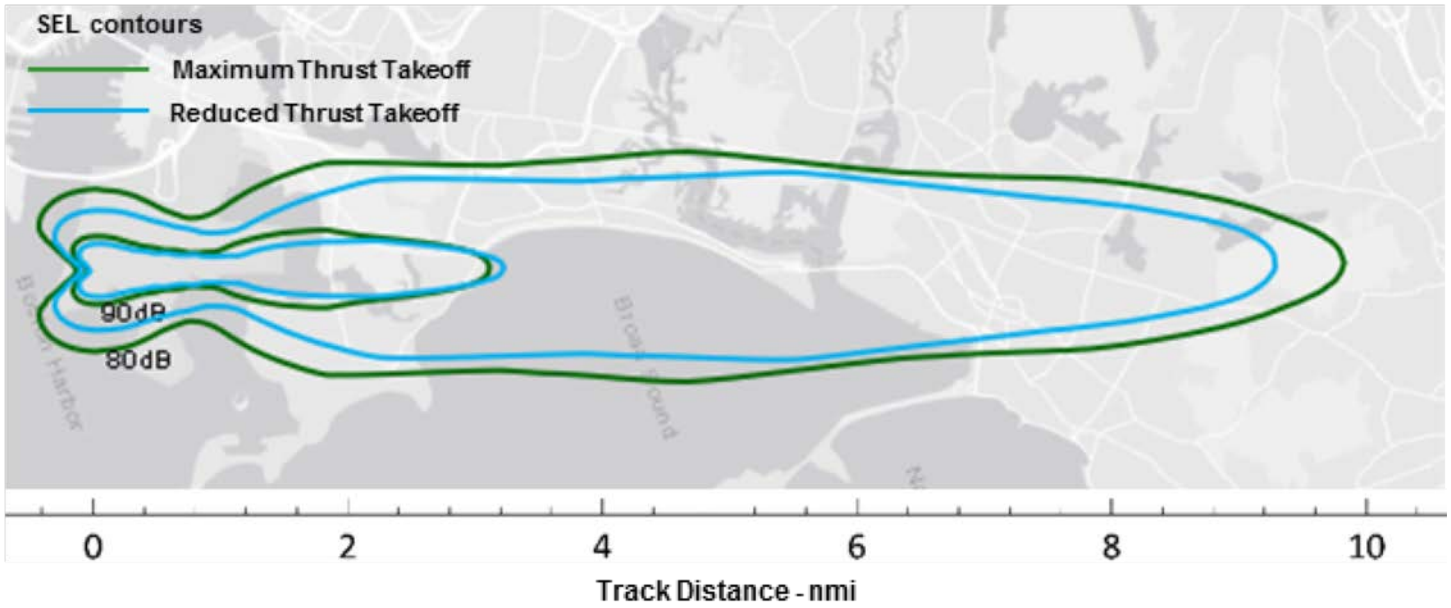


	Length (m)			Area (sq m)		
SEL dB	Baseline	RTT	Diff	Baseline	RTT	Diff
85	14.7	15.7	6.8%	6.2	5.1	-17.8%

Reduced Thrust Takeoff







User Defined Aircraft Profiles

- **With AEDT 3b, users can define profiles that take full advantage of BADA 4's detailed configurations and methods for higher fidelity terminal area modeling**

Add new profile | Delete selected profile

Name	Profile Type	Weight (lb)	Stage Length	Operation Type
STANDARD_B4	Procedural	131000	1	Approach

Step Number	Step Type	Flap ID	BADA4 Configuration	Thrust Level	Altitude AFE (ft)	Calibrated Airspeed (kt)	Climb Rate (ft/min)	Distance (ft)	Thrust (lbf)	Percent (%)	Angle (°)
1	Idle Thrust Descend		Unknown/LGUP	Unknown Thrust	6000	250					3.5
2	Idle Thrust Level		Unknown/LGUP	Unknown Thrust	3000	250		16811			
3	Idle Thrust Level		Unknown/LGUP	Unknown Thrust	3000	201.1		5547.9			
4	Idle Thrust Descend		Unknown/LGUP	Unknown Thrust	3000	182.2					3
5	Idle Thrust Descend		Unknown/LGUP	Unknown Thrust	2614	173.7					3
6	Idle Thrust Descend		Unknown/LGUP	Unknown Thrust	1942	141					3
7	Descend	FULL_D	FULL /LGDN	Unknown Thrust	1823	132.6					3
8	Descend	FULL_D	FULL /LGDN	Unknown Thrust	50	132.6					3
9	Land	FULL_D	Unknown/LGDN	Unknown Thrust				303.5			
10	Landing Decelerate		Unknown/LGDN	Reversed Thrust		129.6		2731.6		40	
11	Landing Decelerate		Unknown/LGDN	Reversed Thrust		30		0		10	

Emissions Dispersion Modeling Updates

- **New airport infrastructure projects result in more NEPA reviews**
  - Current process is time consuming and resource intensive
  - Streamlining of the environmental review process is desired for avoiding delays in infrastructure project milestones
- **U.S. EPA's promulgation of new 1-Hour NO2 NAAQS is a challenge for airports**
  - Current AEDT implementation makes modeled NAAQS and NEPA compliance difficult to achieve
  - AEDT needs to be updated to give access to all the necessary AERMOD/AERMET options
  - Improving accuracy of dispersion modeling is important for achieving modeled1-Hour NO2 NAAQS compliance
- **AEDT dispersion modeling updates are focused on providing tools for airports to meet their obligations**
  - Latest versions of AERMOD/AERMET (18081)
  - Three-tiered screening approach to 1-hour NO2 modeling
  - AERMET options for improving accuracy of dispersion modeling

Notes:
1. NEPA: National Environmental Policy Act
2. NAAQS: National Ambient Air Quality Standard
3. AERMOD: The American Society/Environmental Protection Agency Regulatory Model
4. AERMET: Meteorological data preprocessor for AERMOD

FY19 Development Plan: AEDT 3c

- Focus on usability improvements
  - Annualization workflow update
  - Software maintenance and bug fixes
- Continued FLEET ANP Update
- Expanded AERMET functionality
  - Apply ASOS wind speed adjustment
  - Use threshold for 1-minute wind speeds
  - Use Bulk Richardson stable layer processing
  - AERSURFACE preprocessor
- Supersonic LTO noise modeling research
- Harmonization of ANP and BADA 4 procedure modeling

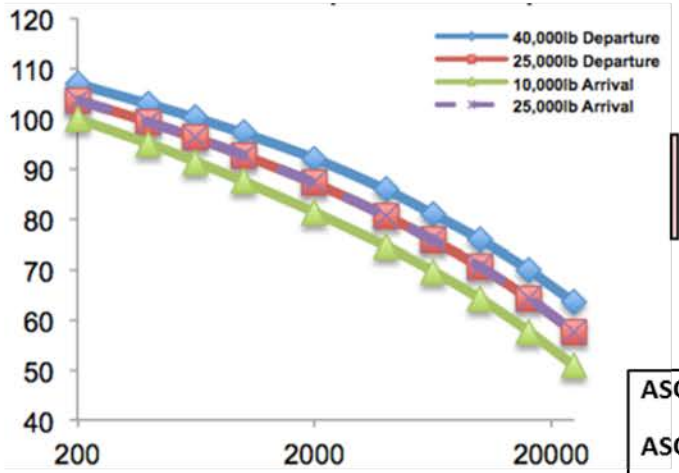
FY19 Development Plan: AEDT 3d

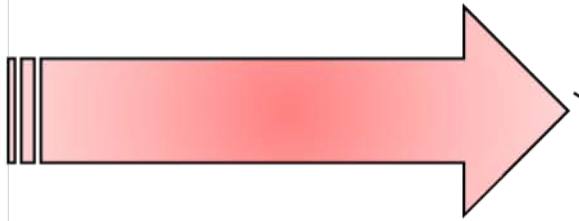
- Focus on supersonic aircraft modeling to support CAEP analyses
  - Full flight performance (fuel burn)
  - LTO noise modeling
- Expand helicopter noise data
  - Introduce polar sphere-based NPD
- Continued usability and maintenance improvements
- Continued FLEET ANP Update

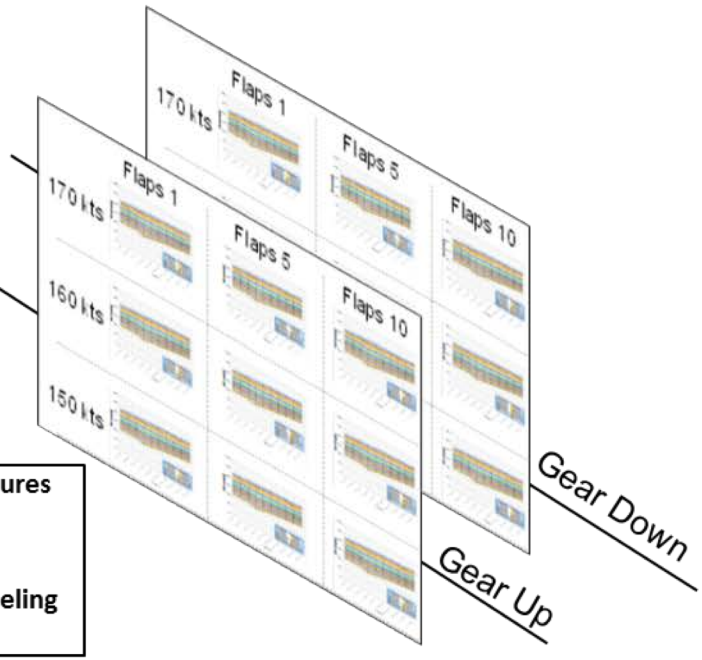
Higher Fidelity Noise Modeling (AEDT 4)

- **More accurately model benefits of NextGen advanced operational procedures and support innovative noise abatement procedure designs aimed at preserving fuel efficiency**

Reference Configuration







ASCENT 23 Noise from Advanced Operational Procedures

ASCENT 43 Noise Power Distance Re-evaluation

ASCENT 44 Aircraft Noise Abatement Procedure Modeling and Validation

Long-Term Dispersion Modeling Goal

- **Short-comings of the current modeling approach**
  - AERMOD produces fictitious model exceedences of the 1-hr NO2 NAAQS for aircraft emissions dispersion modeling
    - Not even close to ambient monitoring data in the vicinity of airports
    - AERMOD is designed for stationary sources; not appropriate for moving sources
  - In AEDT aircraft exhaust emissions characterized as area sources, which is overly conservative
    - Aircraft jet exhaust emissions need special treatment
- **Options for improved dispersion model for aircraft emissions**
  - ASCENT Project 19 will perform a comprehensive review of AEDT/AERMOD's approach to model aircraft sources and current science on aircraft emissions dispersion modeling
  - Potential outcomes could include:
    - Improved version of EPA's AERMOD, or
    - A brand new model reflecting the best science and algorithms, or
    - An adaption of CMAQ for airport emissions

Notes:
1. CMAQ: Community Multiscale Air Quality Modeling System

AEDT Future Development Goals

ACRP 02-27 Aircraft Taxi Noise Database
ACRP 02-52 Noise Modeling of Mixed Ground Surfaces
ACRP 02-55 Enhanced AEDT Modeling of Aircraft Arrival and Departure Profiles
Volpe helicopter polar sphere research
ASCENT 10 Aircraft Technology Modeling and Assessment
ASCENT 19 Development of Aviation AQ Tool for Airport-Specific Impact Assessment: AQ Modeling
ASCENT 36 Parametric Uncertainty Assessment for AEDT
ASCENT 38 Rotorcraft Noise Abatement Procedures Development
ASCENT 45 Takeoff/Climb Analysis to Support AEDT APM Development
ASCENT 46 Surface Analysis to Support AEDT APM Development

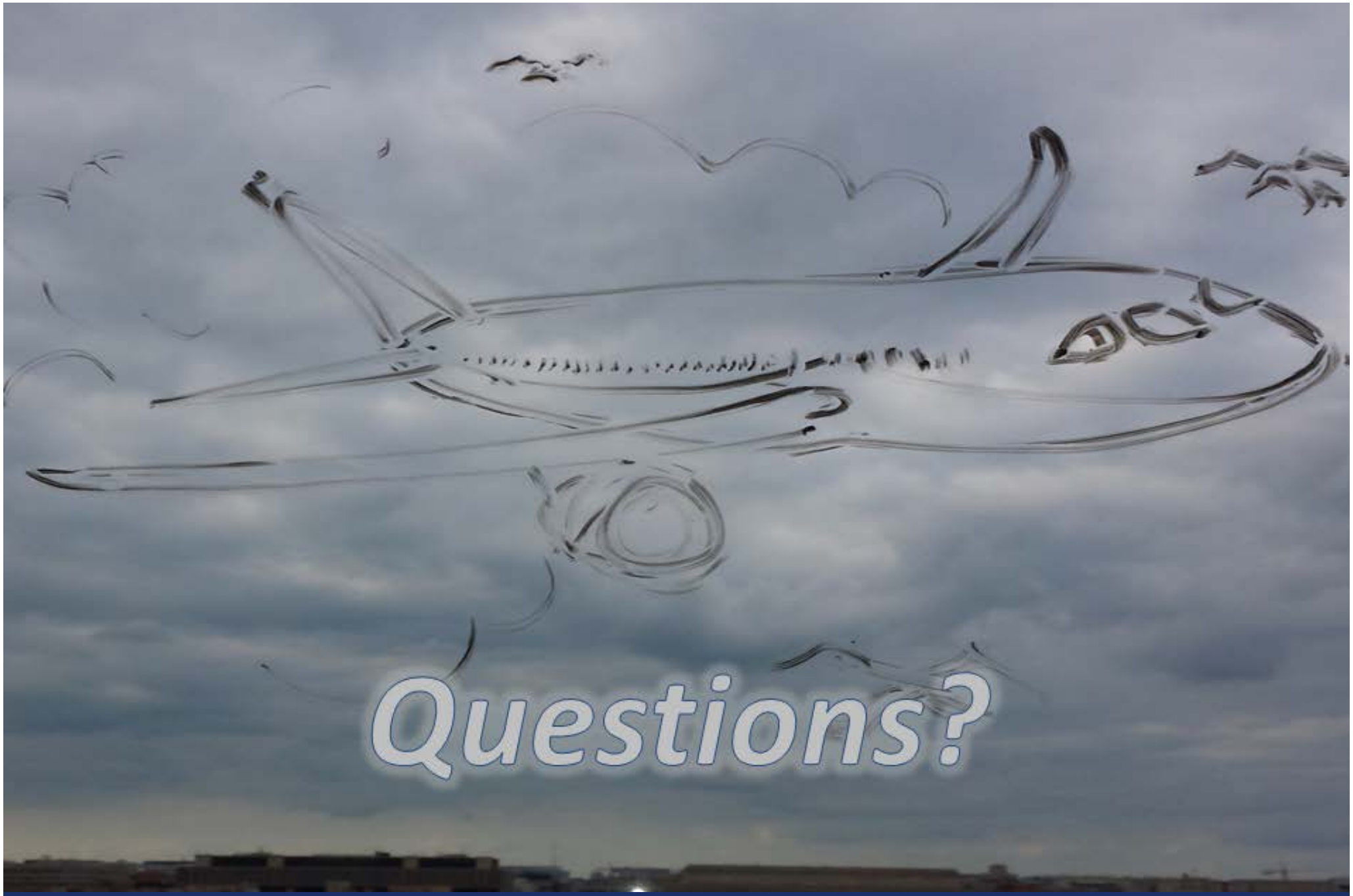
ACRP 02-66 Commercial Space Operations Noise and Sonic Boom Modeling and Analysis
ACRP 02-79 Aircraft Noise with Terrain and Manmade Structures
ACRP 02-81 Commercial Space Operations Noise and Sonic Boom Measurements
ACRP 02-85 Commercial Space Vehicle Emissions Modeling
ASCENT 9 GIS-based Noise Estimation Tool
ASCENT 19 - Development of Aviation AQ Tool for Airport-Specific Impact Assessment: AQ Modeling
ASCENT 23 Noise from Advanced Operational Procedures
ASCENT 36 Parametric Uncertainty Assessment for AEDT
ASCENT 40 Quantifying Uncertainties in Predicting Aircraft Noise in Real-world Situations
ASCENT 43 Noise Power Distance Re-Evaluation (Research)
ASCENT 44 Aircraft Noise Abatement Procedure Modeling and Validation

- Supersonic Aircraft performance modeling
- Infrastructure and usability updates to improve efficiency and workflow
- Aircraft database updates
- Enhance noise modeling for airports near water
- Taxiway Modeling (Noise and Emissions)
- Helicopter noise modeling improvements
- Air quality modeling enhancements

- Higher fidelity aircraft noise characterization
- Update GIS engine to reduce development costs
- Modeling noise with Terrain and Manmade Structures
- Commercial Space
- New Air Quality model

AEDT 3x – Release AEDT updates biannually

AEDT 4a | **AEDT 4x**


Questions?