AEDT Status and Development Plan

Presented to: E&E REDAC Subcommittee

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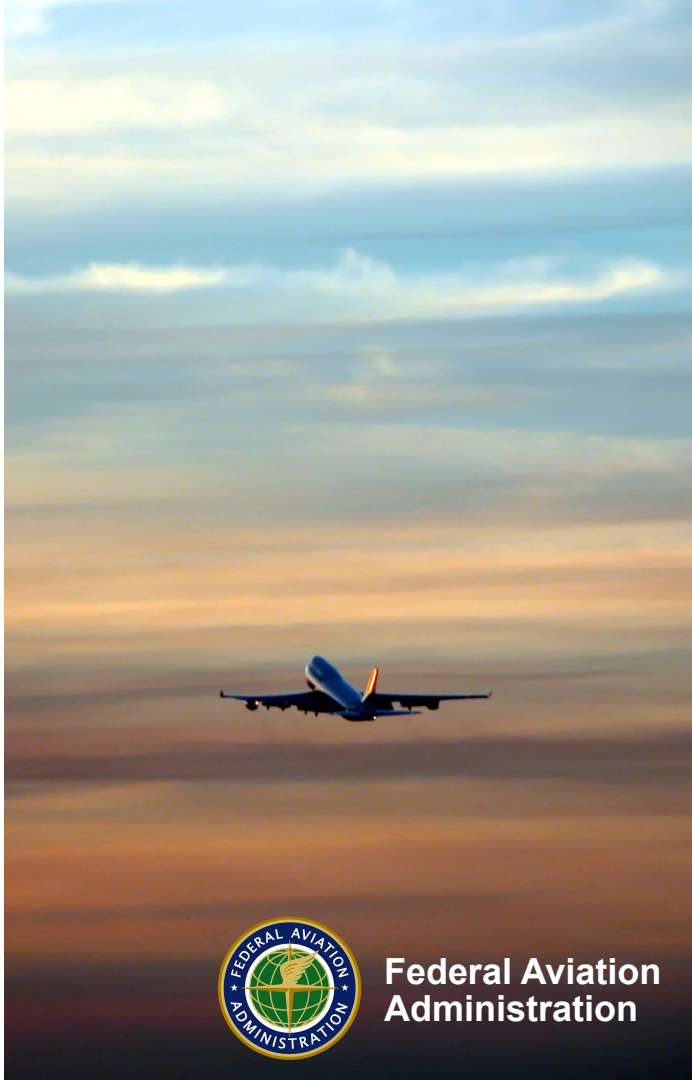
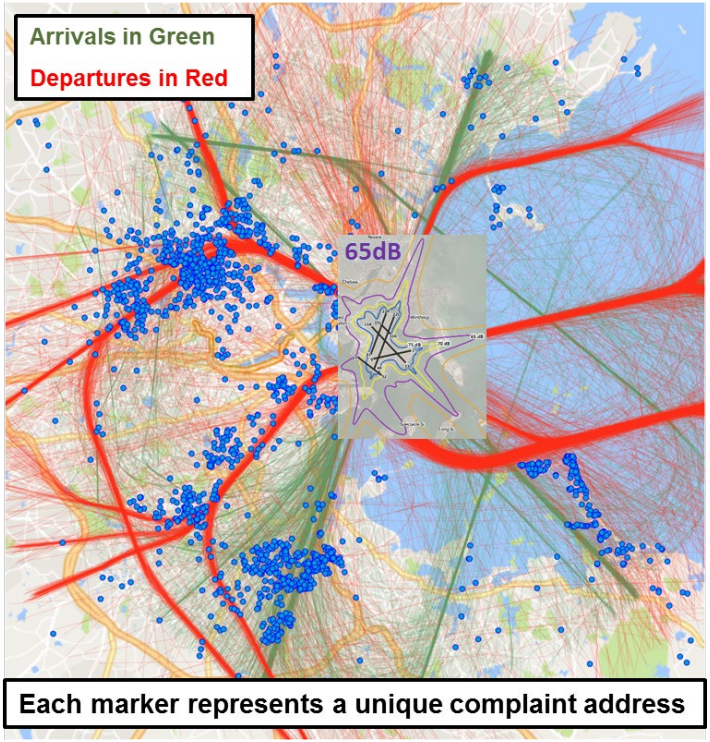


Outline

- **Current AEDT Development Focus**
  - Advanced Operational Procedure Modeling
  - Improved Air Quality Dispersion Modeling
- **AEDT Current Status**
- **AEDT Near Term Development (FY19 – FY21)**
- **AEDT Future Development (FY22+)**
- **Summary**

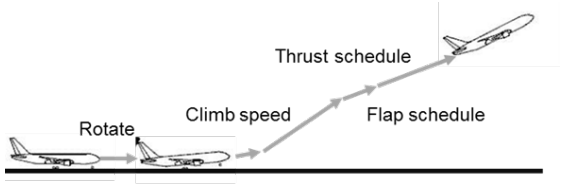
Current Aviation Noise Challenge

- 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

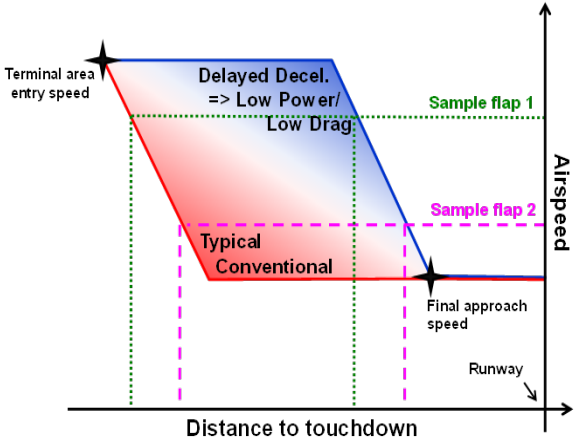


AEDT Noise and Performance Modeling Gaps

- AEDT performance model designed for cumulative metrics like DNL.
  - Aircraft profiles represent annual average operations
  - Low fidelity lift and drag data
- AEDT aircraft source noise data assumes noise is engine dominant
  - No accounting of noise effects for different flap/gear settings.
  - As engine noise is reduced, airframe noise becoming important, particularly on approach.
  - Dominant aircraft noise sources vary during takeoff/approach profiles
- Higher fidelity performance and noise characterization needed to evaluate advanced operational procedures.



Takeoff Profile



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

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.

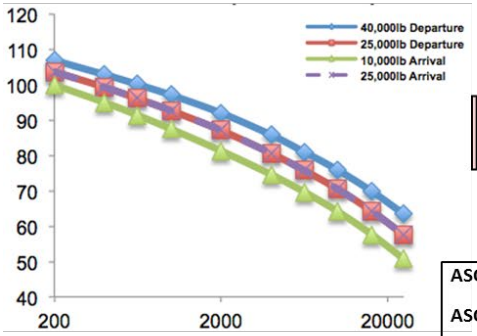
- **Aircraft data gaps**
  - Certain models have incomplete data; some data are estimated
  - Low altitude (below 1500 feet) data not available for some aircraft models
  - No aircraft departure or arrival procedure data
  - Still reliant on ANP database for aircraft data gaps and procedural profiles

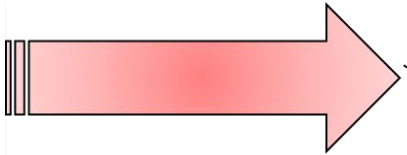
- **Maintenance of use agreement**

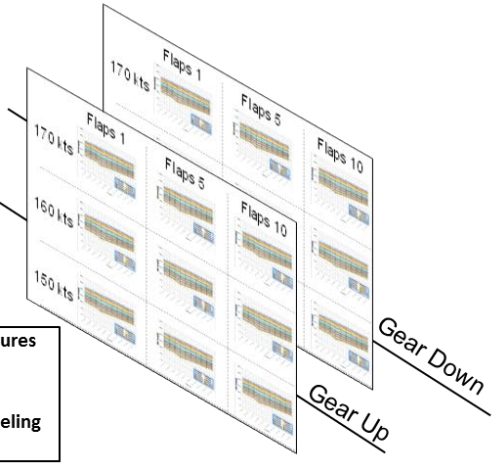
Higher Fidelity Noise Modeling (AEDT 4)

- **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

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

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 3 Status

- **AEDT 3a completed December 2018**
  - Not for public release
  - BADA 4 use agreement with EUROCONTROL pending
- **AEDT 3b scheduled for public release in late 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
- **Aviation emissions dispersion modeling updates in AEDT 3b**
  - AERMOD/AERMET update to latest version
  - Three-tiered screening approach to NO2 modeling
  - AERMET updates
- **Fleet database updates**
  - Gulfstream G650; Boeing 737- MAX8; Boeing 737-800 Approach; Airbus 320-271Neo, Falcon 900, Airbus 350-941

FY19 Development Plan: AEDT 3c

- **Focus on usability improvements**
  - User workflow update to improve efficiency
  - Software maintenance and bug fixes
- **Continued Aircraft Fleet Database Update**
  - Improve noise and performance modeling accuracy
- **Expanded AERMET functionality**
  - Some more AERMET options for improving accuracy of dispersion modeling
- **Supersonic LTO noise modeling research**

FY19 Development Plan: AEDT 3d

- **Focus on supersonic aircraft modeling to support ICAO/CAEP analyses**
  - Full flight performance (fuel burn)
  - LTO noise modeling
- **Expand helicopter noise data**
- **Continued Aircraft Fleet Database Update**
- **Emissions dispersion updates**
  - Improve aircraft emissions characterization
  - Provide EPA's AERMOD/AERMET updates to AEDT users

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

2020 2021 2022 2023

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

AEDT 3x – Release AEDT updates biannually

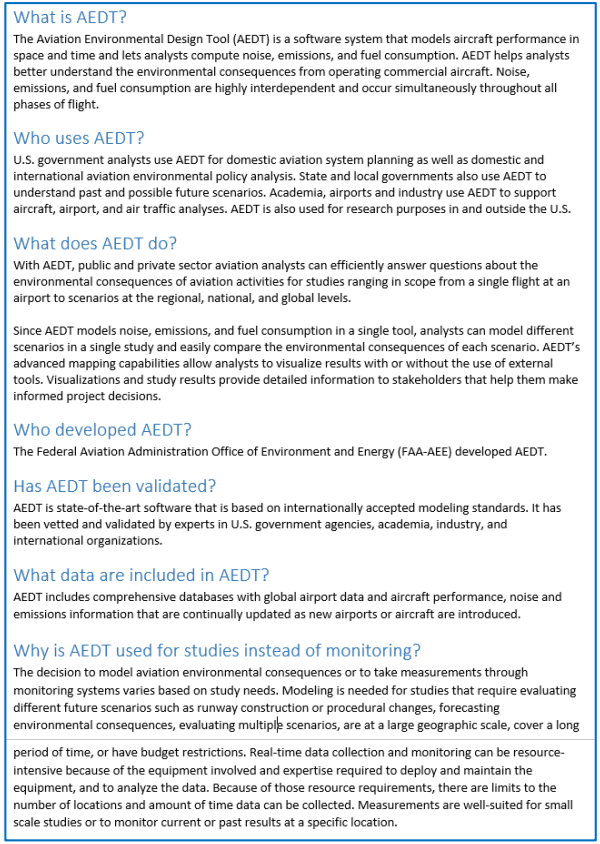
- Higher fidelity aircraft noise characterization
- Update GIS engine to reduce development costs
- Modeling noise with Terrain and Manmade Structures
- New Air Quality model

AEDT 4 series

Action Item

Develop a means to communicate information on AEDT to the layperson. This could include its noise and emissions modeling capabilities and how it reduces the need for noise and emissions monitoring

- We have begun developing content for a new section in the AEDT website that will be designed to explain AEDT and its use to the layperson
- Initial draft of the FAQ style section is under review
- FAQ will provide links to individual pages that will further expand on each topic



What is AEDT?

The Aviation Environmental Design Tool (AEDT) is a software system that models aircraft performance in space and time and lets analysts compute noise, emissions, and fuel consumption. AEDT helps analysts better understand the environmental consequences from operating commercial aircraft. Noise, emissions, and fuel consumption are highly interdependent and occur simultaneously throughout all phases of flight.

Who uses AEDT?

U.S. government analysts use AEDT for domestic aviation system planning as well as domestic and international aviation environmental policy analysis. State and local governments also use AEDT to understand past and possible future scenarios. Academia, airports and industry use AEDT to support aircraft, airport, and air traffic analyses. AEDT is also used for research purposes in and outside the U.S.

What does AEDT do?

With AEDT, public and private sector aviation analysts can efficiently answer questions about the environmental consequences of aviation activities for studies ranging in scope from a single flight at an airport to scenarios at the regional, national, and global levels.

Since AEDT models noise, emissions, and fuel consumption in a single tool, analysts can model different scenarios in a single study and easily compare the environmental consequences of each scenario. AEDT's advanced mapping capabilities allow analysts to visualize results with or without the use of external tools. Visualizations and study results provide detailed information to stakeholders that help them make informed project decisions.

Who developed AEDT?

The Federal Aviation Administration Office of Environment and Energy (FAA-AEE) developed AEDT.

Has AEDT been validated?

AEDT is state-of-the-art software that is based on internationally accepted modeling standards. It has been vetted and validated by experts in U.S. government agencies, academia, industry, and international organizations.

What data are included in AEDT?

AEDT includes comprehensive databases with global airport data and aircraft performance, noise and emissions information that are continually updated as new airports or aircraft are introduced.

Why is AEDT used for studies instead of monitoring?

The decision to model aviation environmental consequences or to take measurements through monitoring systems varies based on study needs. Modeling is needed for studies that require evaluating different future scenarios such as runway construction or procedural changes, forecasting environmental consequences, evaluating multiple scenarios, are at a large geographic scale, cover a long

period of time, or have budget restrictions. Real-time data collection and monitoring can be resource-intensive because of the equipment involved and expertise required to deploy and maintain the equipment, and to analyze the data. Because of those resource requirements, there are limits to the number of locations and amount of time data can be collected. Measurements are well-suited for small scale studies or to monitor current or past results at a specific location.

Summary

- **AEDT 3b will be first public release with BADA 4 implementation**
  - Higher fidelity performance capability
  - Enhanced user flexibility for departure modeling
- **AEDT 3c & 3d will focus on CAEP support**
  - Supersonic performance (fuel burn) and LTO noise
- **ASCENT will continue to support near term (AEDT 3x) and future (AEDT 4) development**
  - ASCENT projects include helicopter noise modeling, aircraft taxi modeling, high fidelity noise characterization, supersonic aircraft modeling, and air quality modeling