# AEDT Development Update


Presented to: E&E REDAC Subcommittee

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# Outline

- AEDT development drivers and team
- Differences AEDT is making today
- FY17 highlights
- FY18 development
- Future development plan
- Challenges and risks

# AEDT Development Drivers/Uses

- Regulatory requirements (e.g., National Environmental Policy Act (NEPA) reviews, Part 150, Part 161)
- CAEP analyses
  - Noise, Emissions ($NO_X$, $CO_2$, and Black Carbon), Global Market Based Measure (CORSIA)
- NextGen analyses
  - Performance reporting (annual basis)
  - Future goals analysis (out to 2050)
  - Assessing benefits of NextGen
- Technology evaluation (e.g., CLEEN Program)

Notes
1. CAEP = Committee on Aviation Environmental Protection
2. CORSIA = Carbon Offsetting and Reduction Scheme for International Aviation
3. CLEEN = Continuous Lower Emissions, Energy and Noise

# AEDT Development Team

- FAA AEE (Office of Environment & Energy)
- Development team
  - DOT Volpe Center
  - ATAC
  - METRON
  - University of North Carolina
  - Georgia Tech
- Continuous feedback from users in the US and beyond
- Others
  - Aircraft data from manufacturers
  - Models and databases from various institutions
  - Recommendations from advisory groups

# AEDT is Making a Difference (1 of 2)

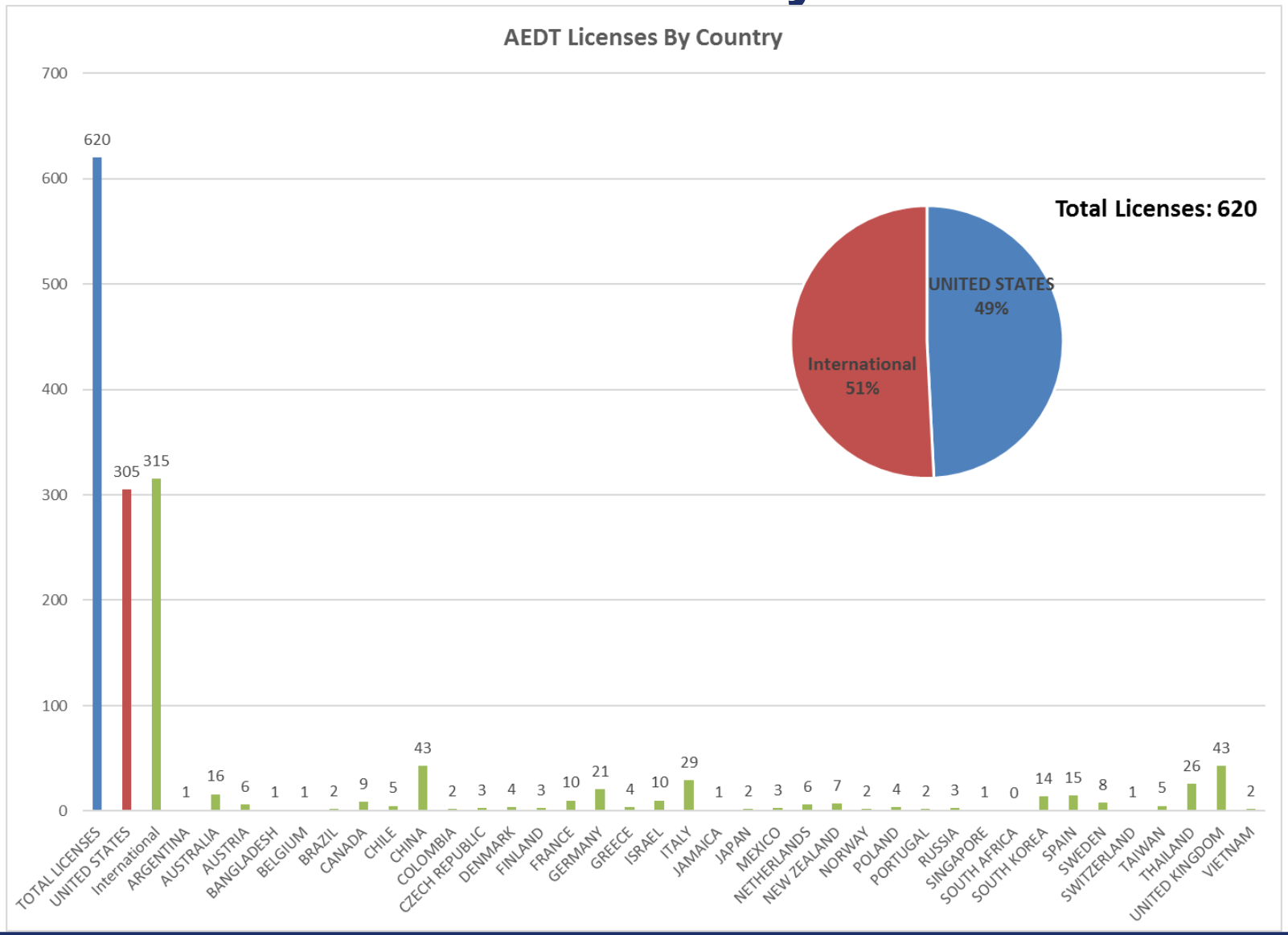
- *AEDT facilitates environmental review activities required under NEPA by consolidating the modeling of aircraft noise, fuel burn, and emissions environmental impacts in a single tool, while different legacy tools were required to compute emissions (EDMS) and noise (INM) impacts separately.*
- *By computing noise, fuel burn and emissions simultaneously, AEDT has improved the efficiency, and reduced the costs of meeting environmental requirements for Federal actions.*
- *Furthermore, AEDT has enhanced air quality modeling capabilities that not only let the user demonstrate compliance with EPA NAAQS of criteria pollutants but also let the user visualize the modeled concentrations in the AEDT GUI, a time and cost saving measure on the part of the user; this was not possible with EDMS.*

Notes:
1. EMDS = Emissions and Dispersion Modeling System
2. INM = Integrated Noise Model
3. EPA = Environmental Protection Agency
4. NAAQS = National Ambient Air Quality Standards

# AEDT is Making a Difference (2 of 2)

- *For FAA actions subject to NEPA and for any project considering community outreach, AEDT provides a new capability of identifying Environmental Justice (EJ) and Limited English Proficiency (LEP) populations. This was not available before.*
- *AEDT has also improved the efficiency and reduced the costs of computing key performance indicators for noise, fuel burn and emissions that are reported on an annual basis.*
- *Additional work is underway to further improve AEDT such that the time and costs for environmental reviews are further reduced.*
- *AEDT helped to ensure U.S. leadership at CAEP in the development of international emissions and noise standards for the aircraft/engine as well as supporting the development of CORSIA.*
- *AEDT is used globally for computing environmental consequences of aviation for a variety of purposes, (e.g., evaluating noise for compliance at Hong Kong International Airport).*

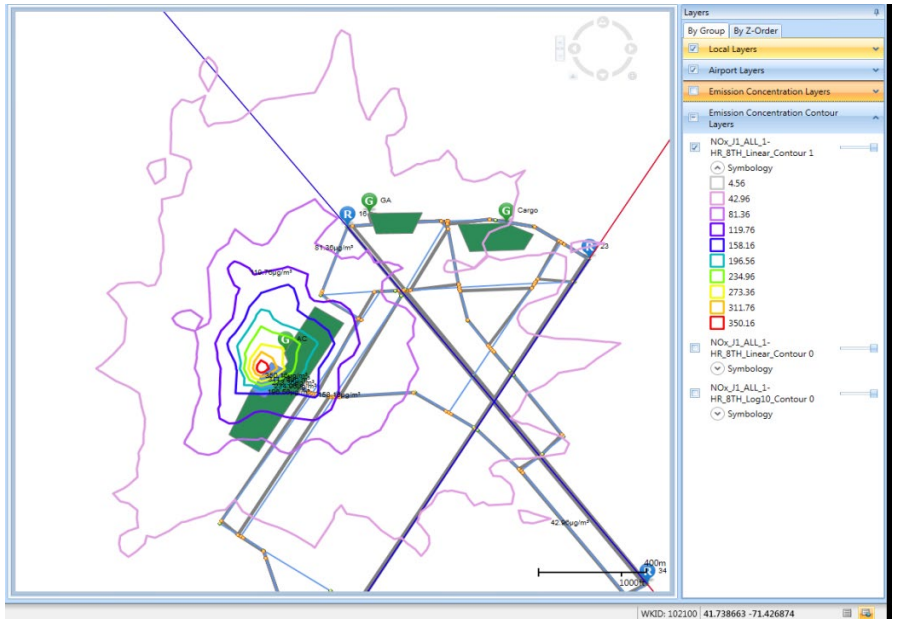
# AEDT Licenses as of January 2018



# AEDT FY17 Highlights 1/2

- Usability
  - Combine contours from different modeling sources
  - Enhance flight track creation tools
  - Bulk editing of flight operations
  - Roadway Network Designer in AEDT GUI
- Emissions improvements
  - High-Fidelity Weather (MERRA-2 & WRF)
  - Background emission concentrations
  - MOVES emissions inventory for VALE reporting
  - Emissions concentration display

| No. | Year | Scenario | Source Group | CO | VOC | NOx | SOx | PM-10 | PM-2.5 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2004 | FlightsFuelTankFourDaysJan2004 | | | | | | | |
| | | | Roadways (MOVES) | 0.010 | 0.000 | 0.020 | 0.030 | 0.000 | 0.000 |
| | | | **FlightsFuelTankFourDaysJan2004 Total** | **0.010** | **0.000** | **0.020** | **0.030** | **0.000** | **0.000** |
| | | FlightsFuelTankFourDays_Alt | | | | | | | |
| | | | Parking (MOVES) | 0.210 | 0.000 | 0.220 | 0.230 | 0.000 | 0.000 |
| | | | **FlightsFuelTankFourDays_Alt Total** | **0.210** | **0.000** | **0.220** | **0.230** | **0.000** | **0.000** |
| | | | ***2004 Net ER*** | ***0.200*** | ***0.000*** | ***0.200*** | ***0.200*** | ***0.000*** | ***0.000*** |
| 2 | 2005 | FlightsFuelTankFourDaysJan2004 | | | | | | | |
| | | | Roadways (MOVES) | 0.040 | 0.000 | 0.050 | 0.060 | 0.000 | 0.000 |
| | | | **FlightsFuelTankFourDaysJan2004 Total** | **0.040** | **0.000** | **0.050** | **0.060** | **0.000** | **0.000** |
| | | FlightsFuelTankFourDays_Alt | | | | | | | |
| | | | Parking (MOVES) | 0.240 | 0.000 | 0.260 | 0.270 | 0.000 | 0.000 |
| | | | **FlightsFuelTankFourDays_Alt Total** | **0.240** | **0.000** | **0.260** | **0.270** | **0.000** | **0.000** |
| | | | ***2005 Net ER*** | ***0.200*** | ***0.000*** | ***0.210*** | ***0.210*** | ***0.000*** | ***0.000*** |




Notes:
1. MERRA = Modern Era Retrospective analysis for Research and Applications
2. WRF = Weather Research and Forecasting Model
3. MOVES = Motor Vehicle Emission Simulator
4. VALE = Voluntary Airport Low Emissions Program

# AEDT FY17 Highlights 2/2

- Noise improvements
  - Fleet database updates – new Aircraft Noise and Performance (ANP) data
  - Dynamic grid for dB and non-dB metrics
- CAEP / NextGen Development (not for public release)
  - Non-volatile Particulate Matter (nvPM) enhancements
  - BADA4 with sensor path capability

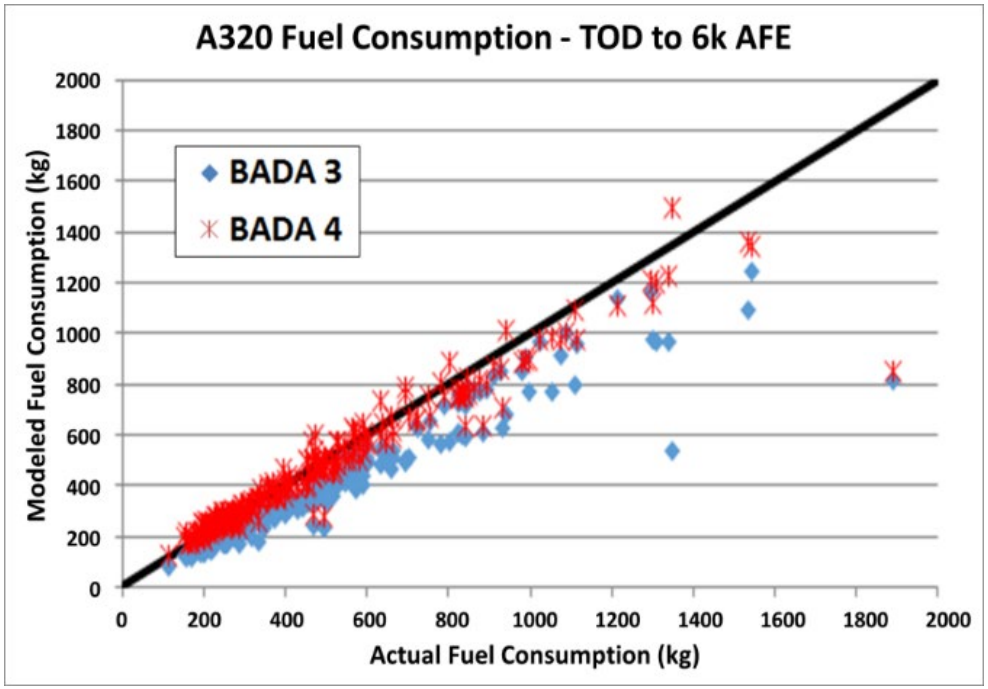
# AEDT updates in 2018

- AEDT 2e (April, 2018)
  - Fleet database update
    - Airbus A350,  A320-/A321-neos
  - Line of Sight blockage efficiency improvements for parks noise analyses
  - Open contours for noise analyses
  - nvPM methods for CAEP analysis

- AEDT 3a (September, 2018)
  - Aircraft performance modeling update
    - BADA4 implementation → 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
  - Dynamic grid modeling for noise contours
  - Fleet database updates – G650, A320 neo PW and ATR-72

# BADA 4: Improved Performance for AEDT Modeling

- BADA 4 will improve accuracy of fuel burn calculation below cruise.
  - Necessary for NextGen procedure benefits analysis
- BADA 4 allows for one performance model runway to runway, eliminating data mismatches between performance models.




- Higher fidelity BADA 4 performance data will allow for more detailed procedure modeling
  - Captures configuration and speed changes of advanced operational procedures

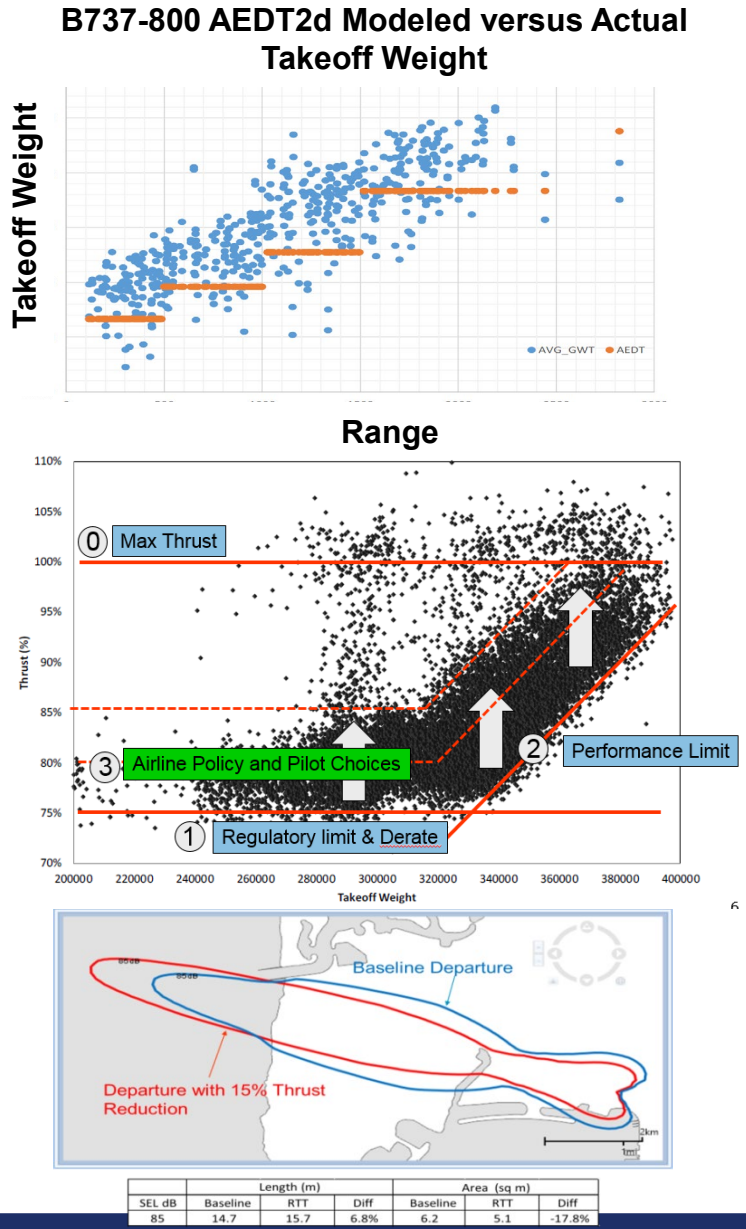
# Base of Aircraft Data (BADA) 4 for Public Use

- BADA 4 for public use in AEDT 3a release
  - Currently *not publicly* available (AEDT use only approved for CAEP and NextGen analyses)
  - EUROCONTROL and manufactures have agreed to the public release of BADA 4 in AEDT
  - FAA is in the process of working with EUROCONTROL on the BADA 4 agreement for public use

# AEDT3a: Aircraft Takeoff Weight and Thrust Model

- Aircraft takeoff weight and thrust are critical parameters in environmental modeling.
- Accurate estimate of the parameters has been historically challenging.
- Limited data available and assumptions:
  - Payload load factor at 65%
  - Standard departure profiles assumes maximum thrust at takeoff

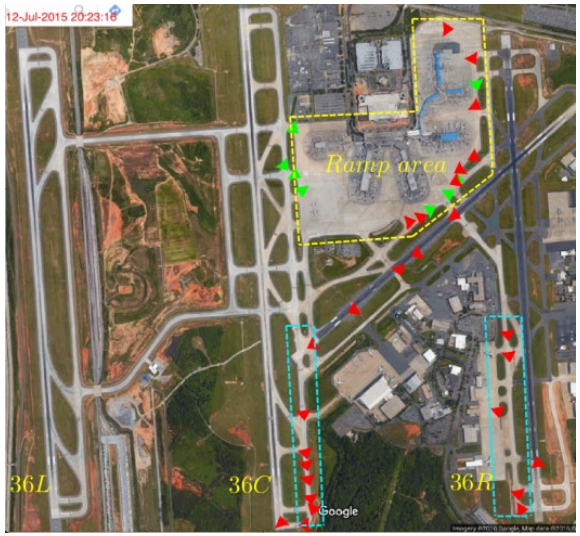
- <u>Research:</u> analyzed airline data and recommended options for improvement
  - ASCENT 35/45
  - Other related projects



# FY19 Development Plan (AEDT 3b)

## ➢ Improved taxiway modeling

- ASCENT 46 Surface Analysis to Support AEDT APM Development
- Develop statistical models of taxi performance (from FDR and ASDE-X data) that are representative of a wider range of taxi conditions, aircraft types, airports, airlines, and weather conditions
- An improvement over the current simplistic approach used in AEDT



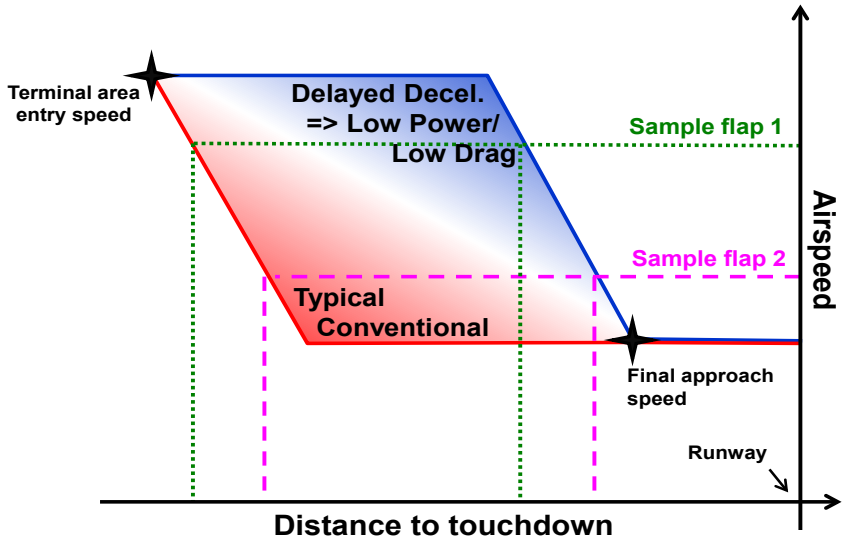

## ➢ Re-evaluation of ESRI

- Investigate open source GIS software as alternative to ESRI GIS
- To meet current and future needs of AEDT users
- Potentially use outputs from NET-NE ASCENT Project

# Planning for AEDT 4

## FY20 and Beyond (AEDT 4)

- Improved version of AERMOD for local-scale airport air quality modeling
- Explore options to include capabilities to model supersonic aircraft
- **Higher fidelity noise characterization**
  - Utilize improved aircraft performance from BADA 4
  - Develop analytical techniques to capture airframe noise (ASCENT 23)
  - Develop NPD plus configuration (NPDC) format that enables more accurate noise prediction due to aircraft configuration and speed changes (ASCENT 43)




- Supersonic aircraft modeling
- Commercial space modeling
- Improved air quality dispersion
- Stratified atmosphere for sound propagation

# AEDT Future Development Goals

ACRP 02-55 Enhanced Arrival and Departure
ACRP 02-41 Takeoff Thrust
Volpe BADA 4 Noise Implementation
ASCENT 35 Airline Flight Data
ASCENT 36 AEDT UQ
ASCENT 45 Takeoff/Climb Analysis
ASCENT 46 Surface Analysis

ACRP 02-27 Aircraft Taxi Noise Database
ACRP 02-52 Noise Modeling of Mixed Ground Surfaces
ACRP 02-79 Aircraft Noise with Terrain and Manmade Structures
ASCENT 23 Noise from Advanced Operational Procedures
ASCENT 43 Noise Power Distance Re-evaluation
ASCENT 10 Technology Evaluation

ASCENT 38 helicopter noise
ASCENT 40 noise propagation
ACRP 02-81
Commercial space noise and sonic boom study
ACRP 02-85
Commercial space emission modeling
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2018 2019 2020 2021 2022 2023 20xx

- **Model Advanced Operational Procedures (Performance)**
- **Improved Takeoff Weight Estimation**
- **Reduced Thrust Takeoff**
- **Improved Taxiway Modeling (Fuel burn)**

**AEDT 3**

- **Supersonic aircraft performance**
- **Model Advanced Operational Procedures**
- **Mixed Ground Types**
- **Terrain Modeling**
- **Improved Taxiway Modeling (Noise)**

**AEDT 4**

- **Improved helicopter noise, fuel burn and emissions models**
- **Commercial space modeling**
- **Improved air quality dispersion modeling**
- **Stratified atmosphere for sound propagation**

**AEDT 4X**

# Challenges and Risks

**Proposed cuts in the development budget would impede Agency's ability to conduct environmental analyses critical to meeting FAA's mission including:**

- FAA's capability to accelerate environmental reviews (e.g., NextGen's PBN implementation)
- Evaluating environmental studies for new entrants, (i.e., supersonic transport aircraft, UAS, commercial space vehicles)
- Maintaining U.S. leadership at CAEP in the development of international emissions and noise standards

***Reduced funding will hinder our ability to create the tools necessary to support these activities.***

# AEDT Contacts

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