Analysis and Tool Development

Status Update

Presented to: REDAC E&E Subcommittee
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Date: September 17, 2020

Federal Aviation Administration

Presentation Outline

- **Technology Welding and Deployment plan Update**

- **Tools Development Update**

- **ASCENT Projects**

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Technology Welding and Deployment (TWD)

- **Reference data infrastructure fabrication**
  - Identify authoritative data sources
  - Establish data paths between authoritative sources and reference databases
  - Develop automated processes for update, validation, and maintenance

- **Data processes infrastructure fabrication**
  - Identify processes that have been developed by other LOBs which generate data and information that are of use to the environmental use case
  - Continue development of those processes that have been built by AEE
  - Work towards the integration of all processes into a single system

- **Tools infrastructure fabrication**
  - Ensure that the all current and upcoming environmental tools link to the established data infrastructure for input and output
  - Support linking of other tools related to this use case (e.g. TARGETS)
  - EVT will be developed to act as the primary portal to the data infrastructure

- **Implement the resulting integrated infrastructure on the FAA Enterprise Information Management (EIM) system**

TWD Data Infrastructure
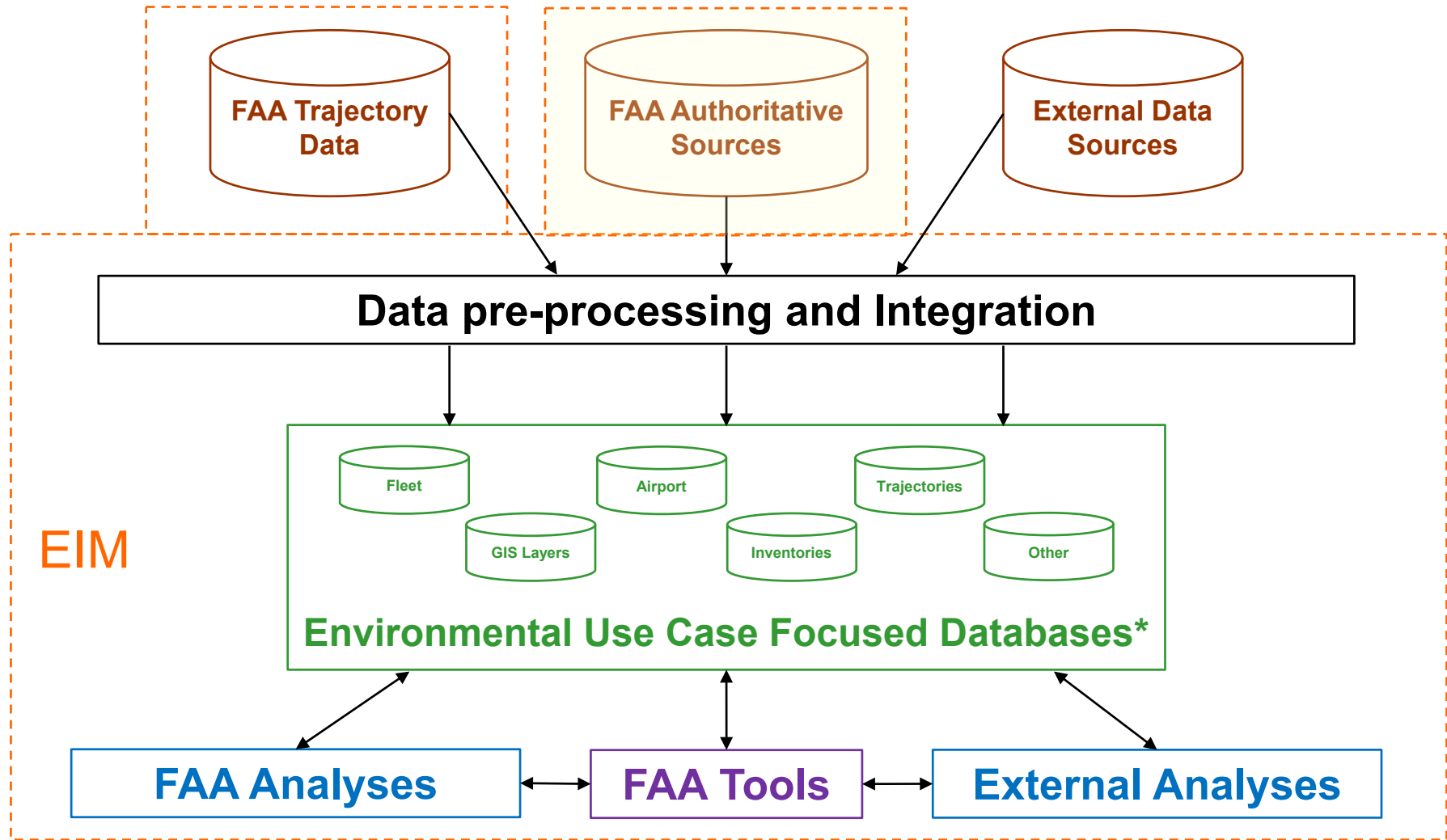
*While the development driver is the environmental use case, these databases are suitable for a much larger set of FAA applications.

Data Infrastructure Update

- **AEDT Fleet database**
  - Work continues on evaluating and revising the database development process, refactoring the software codebase, and reassessing the quality and validity of the data in the current database
  - Full review of the data planned for the AEDT 3d release
- **Registration of FLEET and AIRPORT databases in the DGC**
  - The Data Governance Center (DGC) is a centralized data storage system within the FAA to access all enterprise data
  - The AEDT databases have been identified as being critical data assets to be included in the initial collection campaign
  - The DGC will provide the infrastructure needed to ensure access to authoritative data

AEDT-Ready Trajectory Data Processing Infrastructure

- **AEDT-Ready flight trajectory data**
  - An AEDT focused process (AEDT-TT) processes MITRE ThreadedTracks (TT) trajectory data to augment the associated metadata and optimize it for the AEDT performance model
  - The output of this process is being used to generate the AEE annual NAS noise and emissions inventory for CY2019
  - Refinements the process are now focusing on improving the quality of the data closer to the ground in the terminal area

- **Space-Based ADS-B (SBA) Data**
  - AEE has joined a year-long data evaluation task group of the Aireon SBA product
  - Has the potential to improve and expand modeling capabilities by providing access to aircraft onboard sensors data
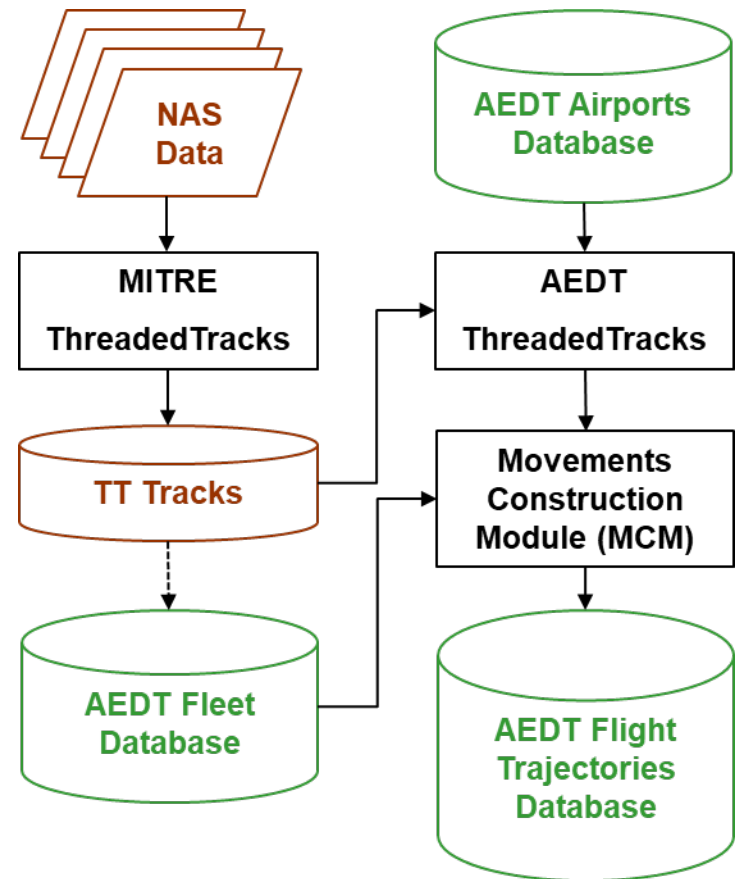
Planned Environmental Data and Tools Portal Infrastructure
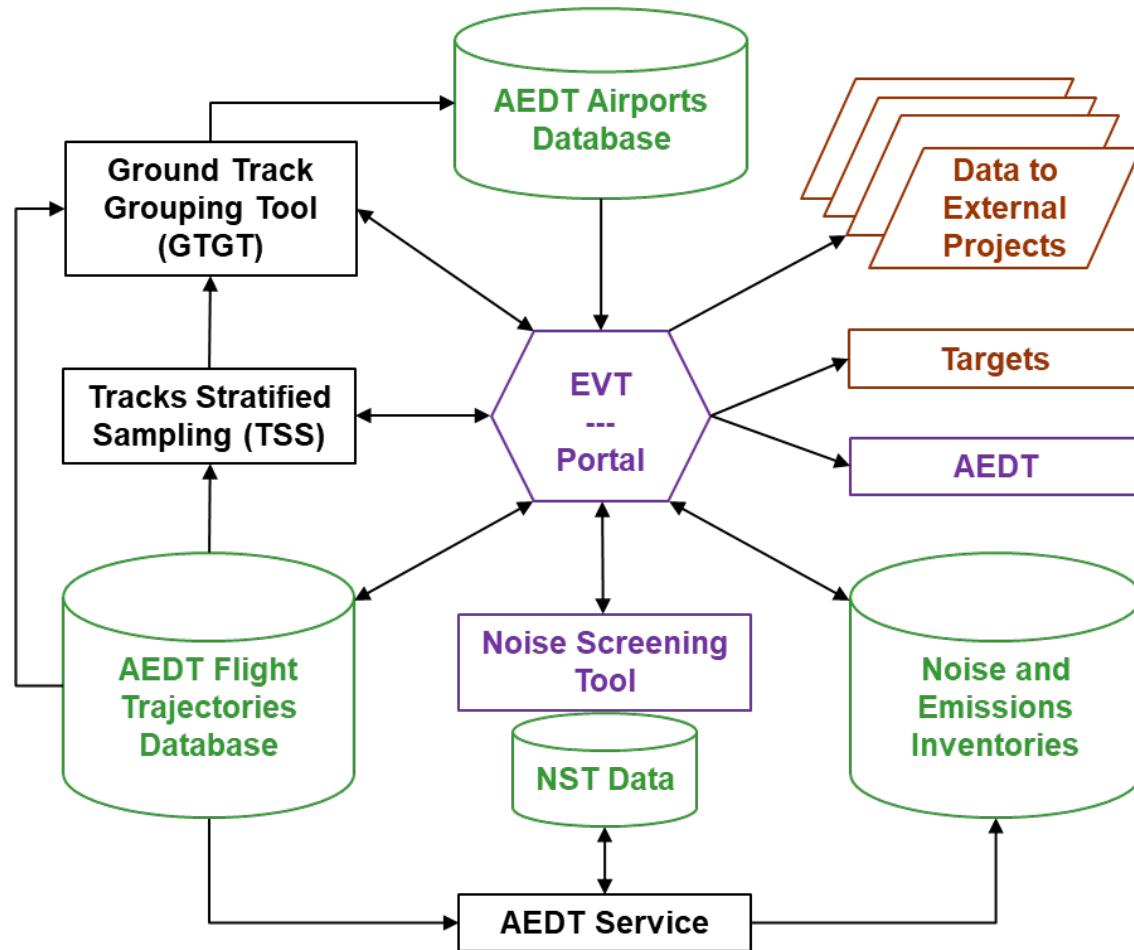
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AEDT 3c

- **AEDT 3c was re-released on June 19, 2020**
  - A database discrepancy and related aircraft performance calculation issue were discovered in the March 6 release which affected use of altitude control codes
  - The new release was a mandatory technical update
- **The new release included**
  - Code update to prevent use of BADA 4 data where ANP/BADA 3 was intended
  - The algorithm used to calculate aircraft trajectory for climb out was improved to handle cases with multiple solutions
  - ANP and BADA 3 mappings for affected aircraft were updated to produce smooth transition from ANP profiles to BADA 3
- **AEDT Release Notes contain a complete listing of resolved issues for AEDT 3c (available at https://aedt.faa.gov)**

AEDT URG External Feedback

- **Launched User Review Group (URG) on April 8, 2020**
  - Select group of power users and novice users invited to provide feedback on AEDT
  - URG helped to develop list of features and enhancements for future releases of AEDT (some included in AEDT 3d feature list)
  - Group remains fully engaged and is providing valuable feedback on AEDT 3d Sprint releases

- **External audit of AEDT development process**
  - Completed final report on AEDT development process and scheduled report brief out to AEE AEDT management team.
  - Provided immediate and longer term recommendations to improve AEDT quality and development team efficiency
  - Provided clear definitions of roles and responsibilities of key AEDT development team leadership positions to improve efficiency and predictability of release cycles
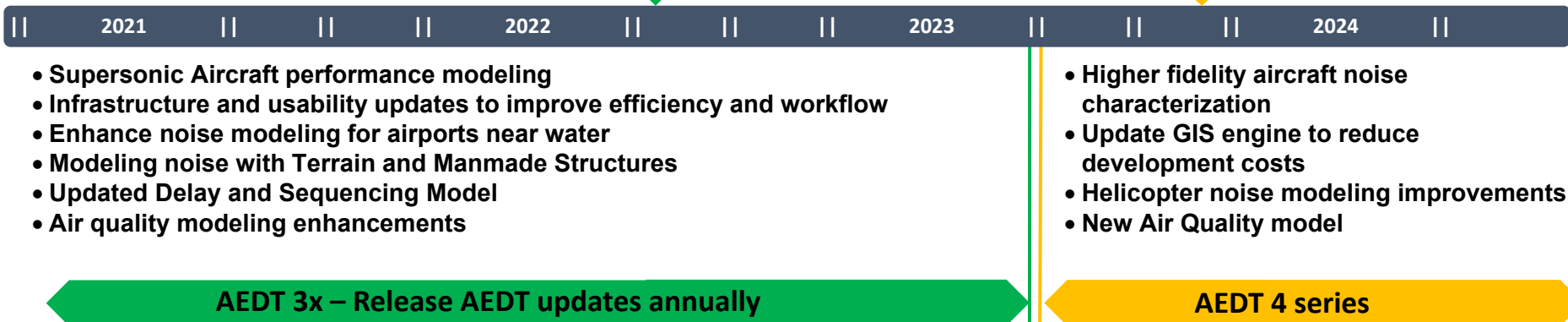
AEDT 3d Development Plan

- **Focus on AEDT maintenance**

- **Fleet database updates**
  - Boeing 767-300ER

- **Thorough review of AEDT Fleet database mappings for aircraft that are not included in the ANP database.**

- **Improve AEDT's emissions dispersion input file preparation**
  - AEDT generates AERMOD input files for multiple pollutants in one pass
  - Eliminates the need to run emissions inventory for each pollutant

- **Emissions Improvements**
  - Improved workflow to generate Speciated Organic Gases (SOG)
  - AERSURFACE version 20060 through AEDT GUI
    - Processes land cover data to determine surface characteristics for use in AERMET

AEDT Future Development Timeline

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 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
ASCENT 54 AEDT Evaluation and Development Support

ACRP 02-79 Aircraft Noise with Terrain and Manmade Structures
ASCENT 9 Geospatially Driven Noise Estimation Module
ASCENT 19 - Development of Aviation AQ Tool for Airport-Specific Impact Assessment: AQ Modeling
ASCENT 23 Noise from Advanced Operational Procedures
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
ASCENT 54 AEDT Evaluation and Development Support
ASCENT 60 Analytical Methods for Expanding the AEDT Aircraft Fleet Database

2021 **2022** **2023** **2024**

- **Supersonic Aircraft performance modeling**
- **Infrastructure and usability updates to improve efficiency and workflow**
- **Enhance noise modeling for airports near water**
- **Modeling noise with Terrain and Manmade Structures**
- **Updated Delay and Sequencing Model**
- **Air quality modeling enhancements**

- **Higher fidelity aircraft noise characterization**
- **Update GIS engine to reduce development costs**
- **Helicopter noise modeling improvements**
- **New Air Quality model**

AEDT 3x – Release AEDT updates annually

AEDT 4 series

New Environmental Visualization Tool (EVT) Release*

- **Just released a new version to the user community**

  – Provides access to the Noise Complaint Initiative (NCI) data

  – Includes Heat Mapping capability for both NCI data and noise exposure data

  – Use of new features supported with the release of quick reference guides

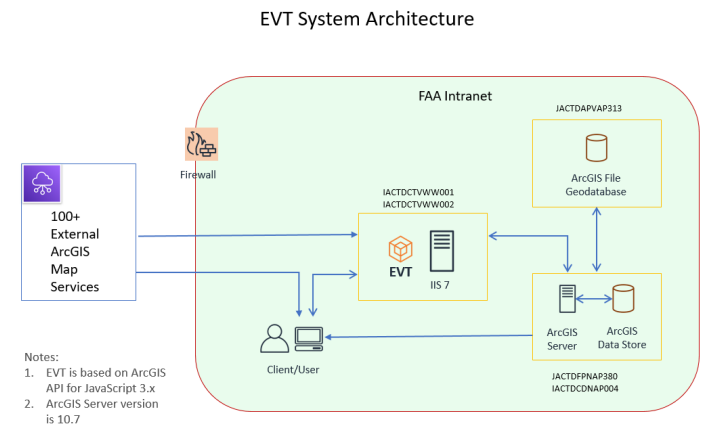 – EVT continues to enjoy increasing visibility and support within FAA
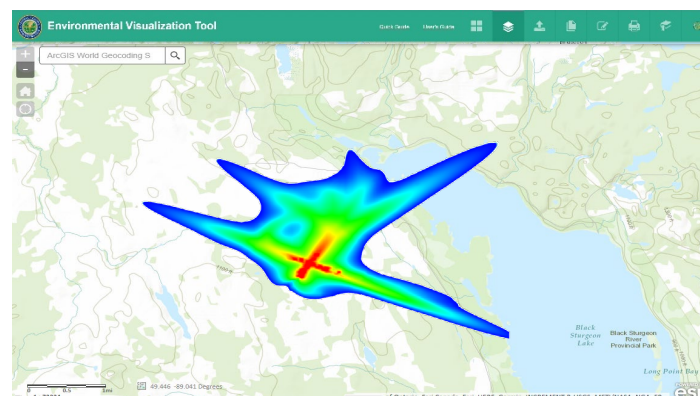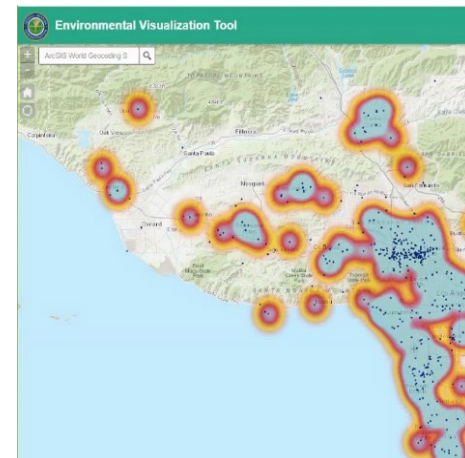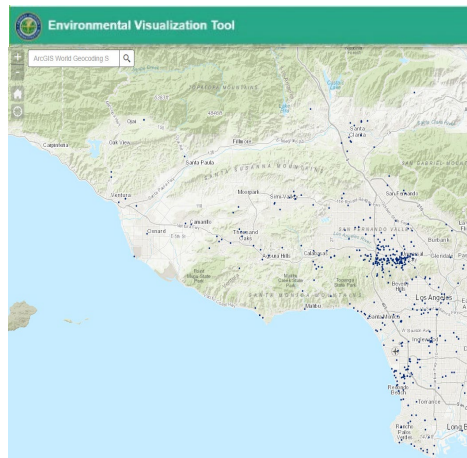
EVT Development and Coordination

- **Development of tool's features continues in coordination with the stakeholder group**
  - Monthly teleconference calls
  - Includes representative from all Service Centers
- **Migration process to the EIM has began**
  - Tool architecture information has been exchanged with the EIM system team
  - Developers access has being grated to the Enterprise ESRI instance running on the EIM
- **Development is ongoing on 3D mapping capability**

EVT System Architecture

FAA Intranet

JACTDAPVAP313

Firewall

100+ External ArcGIS Map Services

IACTDCTVWW001
IACTDCTVWW002

ArcGIS File Geodatabase

EVT   IIS 7

ArcGIS Server   ArcGIS Data Store

Client/User

Notes:
1. EVT is based on ArcGIS API for JavaScript 3.x
2. ArcGIS Server version is 10.7

JACTDFPNAP380
IACTDCDNAP004

Noise Screening Tool Update

- **Implementation Framework**
  - Establishment of AEE Virtual Private Cloud (VPC) under Federal Cloud Resources
  - Coordination with FAA Enterprise Information Management (EIM) Program
  - Coordination with TARGETS development team
  - Flight Track and Modeling Input Data streamlining
  - EVT integration

- **Methodology**
  - Case study validation of Parameterized pre-compiled inputs
  - Assessment of emerging needs: Increasing potential for use of supplemental metrics

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ASCENT Project 9: Geospatially Driven Noise Estimation Module

**Institution / PI:** Georgia Institute of Technology / Dimitri Mavris
FAA PM: Joe Dipardo
Funding: $250,000/yr. for 3 years

Objective: Develop a novel geospatially driven noise estimation module to support computation of noise resulting from the operation of Unmanned Aircraft Systems (UAS) and other upcoming vehicle concepts.

Approach: The development of the module will leverage emerging computational technologies in order to achieve fast and efficient modeling of a potentially large number of vehicles and operations. The module will be designed to be integrated as a component module or plug-in to other applications relying on a Geographic Information System (GIS) interface. The noise estimation approach will be based on the concept of precomputed noise grid tiles addition.

Expected Impact: This research effort will produce a GIS driven noise estimation module that can evaluate the noise exposure that could result from the introduction of large numbers of UAS vehicles into commercial and private use. This module will be able to quickly compute and return noise levels to be overlaid on maps by the hosting application. The resulting visualizations will provide decision-makers insight on where the noise would be distributed or concentrated. This method could also help identify innovative operational concepts to promote sustainable growth of UAS operations by minimizing noise generation over sensitive areas.
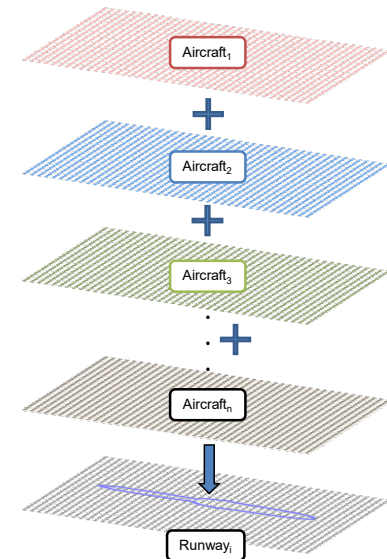
ASCENT Project 53: Validation of Low-Exposure Noise Modeling by Open-Source Data Management and Visualization Systems Integrated with AEDT

Institution / PI: Stanford University / Juan Alonso
FAA PM: Sean Doyle
Funding: $400,000/yr. for 2 years

Objective: The MONA project (Metroplex Overflight Noise Analysis) was started to provide real-time and objective data, analyses, and restakeholders and policy makers to mitigate the noise impacts of the deployment of new NextGen proceduresports to key. The focus of the first year of this ASCENT project was to improve upon the noise predictions of MONA through tighter integration with AEDT.

Approach: The focus of the first year of this ASCENT project is to improve upon the noise predictions of MONA through tighter integration with AEDT. In particular, the project will pursue the following activities: (a) integrate and automate AEDT's noise analysis capabilities, (b) Validate and Verify (V&V) AEDT's noise predictions in 55-65 db DNL areas, and (c) propose software engineering/architectural choices for AEDT v5 to enhance usability in multiple workflows including API formulation, visualization interfaces, and cloud computing and storage.

Expected Impact: Mirroring the specific objectives of the project the envisioned benefits of our Year 2 efforts include (a) ability to automate complex noise analyses in metroplexes so they are available in near-real time after the preceding 24-hr period, (b) a better understanding of the accuracy of AEDT's current noise models in low noise (55-65 db DNL) areas, the reasons for the errors (if any) in existing predictions, and the contributing factors for prediction discrepancies, (c) the development of a data science scalable infrastructure that can serve very large analyses and impact analyses, and (d) a proposal for approach routes into SFO (focusing on the SERFR, BDGA, and PIRAT routes) that have the potential to reduce noise impacts on the overflown public.

ASCENT Project 54: AEDT Evaluation and Development Support

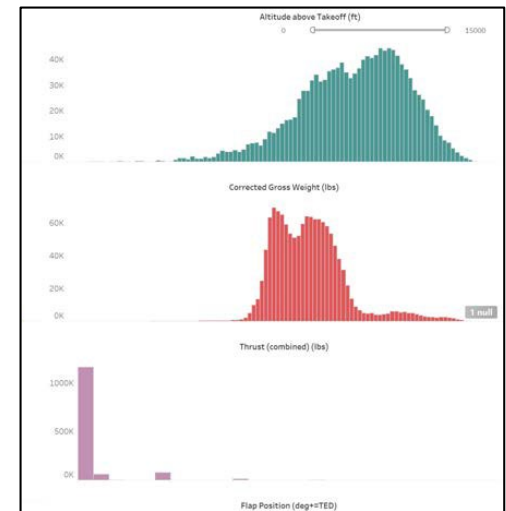**Institution / PI:** Georgia Institute of Technology / Dimitri Mavris & Michelle Kirby
FAA PM: Joe Dipardo
Funding: $700,000/yr. for 3 years

Objective: Provide data and methods to continue to improve the aircraft weight, takeoff thrust, and departure and arrival procedure modeling capabilities within the FAA's Aviation Environmental Design Tool (AEDT).

Approach: Some of the modeling assumptions in AEDT are considered overly conservative, and could be improved through the use of industry and airport flight operational data. This funding would continue to support the implementation of these methods and data into AEDT4. To facilitate this, the Georgia Tech team will utilize real-world data flight and noise monitoring data to improve departure, full flight, and arrival modeling. In addition, this research will provide the FAA AEE office with evaluations and assessments of AEDT's future service pack releases.

Expected Impact: The outcomes of prior research identified gaps in the assumptions of the terminal area procedures within the Aircraft Performance Module (APM), specifically departure profiles that are outdated and arrival procedures that do not reflect current airport operations and enroute modeling. The proposed research will address these gaps and provide recommendations for enhancements to the AEDT APM and implementation support for the AEDT development team. The enhanced modeling assumptions will improve the accuracy of AEDT to better reflect the environmental assessment of aircraft operations.

ASCENT Project 60: Analytical Methods for Expanding the AEDT Aircraft Fleet Database

Institution / PI: Georgia Institute of Technology / Dimitri Mavris & Michelle Kirby
**FAA PM:** Joe Dipardo
Funding: $700,000/yr. for 3 years

Objective: improve the accuracy of Aviation Environmental Design Tool (AEDT) noise and emissions modeling of aircraft not currently in the Aircraft Noise and Performance (ANP) database.

Approach: Georgia Tech (GT) will identify and review the aircraft not currently modeled in AEDT and collect information and necessary data to better understand the characteristics of the aircraft and identify distinct types. Quantitative and qualitative analytical methods will be identified and evaluated for each aircraft type to develop the ANP and noise data for the aircraft, which will then be validated against data from real world flights and physics-based modeling. The projects will develop recommendations and guidelines for how to implement the developed data in AEDT.

Expected Impact: This research will expand the AEDT FLEET database to include the noise and performance data of the aircraft types which are not currently in AEDT through analytical methods. This will improve the noise and emissions modeling of these aircraft and eventually enhance AEDT's environmental modeling capability. The enhanced modeling capability will improve the accuracy of AEDT to better reflect the environmental assessment of the aircraft operations.
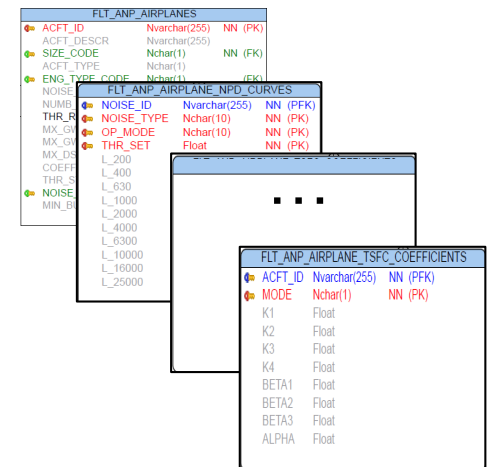
ASCENT Project 62: Noise Model Validation for AEDT

Institution / PI: Georgia Institute of Technology / Dimitri Mavris
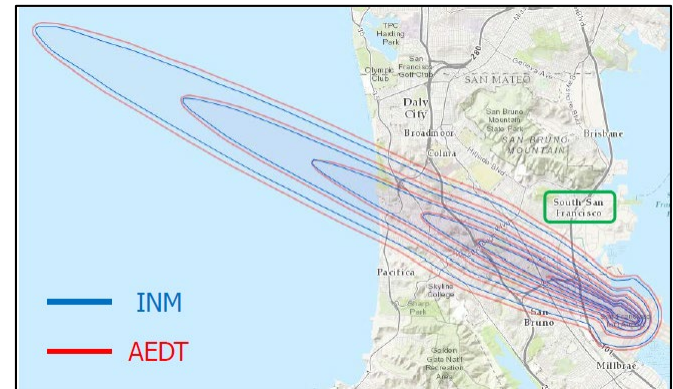Pennsylvania State University / Victor Sparrow
FAA PM: Hua (Bill) He
Funding: $350,000

Objective: This project focus is to assess the accuracy of AEDT in estimating noise in both the vicinity of airports as well as further afield.

Approach: The foundation of AEDT noise modeling is based on the Integrated Noise Modeling (INM) tool, which has undergone a number of validation and verification efforts in the past, specifically at Denver International Airport and showed continually improving agreement of modeling with measurement data. During the development of AEDT, multiple algorithm updates have occurred and this project seeks to quantify the new noise modeling capabilities based on comparison to field measurement data from DIA and other airport monitoring systems. The validation will include modeling of the effects of noise propagation, ground terrain, and meteorological conditions using data from low-earth-orbit satellites.

Expected Impact: This research will provide a noise model validation benchmark that can be used not only to respond to questions on AEDT noise prediction accuracy, but also to allow the tool development team to prioritize further development of modeling features and enhancements that will improve the predictive capability with respect to real world measurement data.

— INM
— AEDT

Questions?