AEDT Development

Presented to: E&E REDAC Subcommittee

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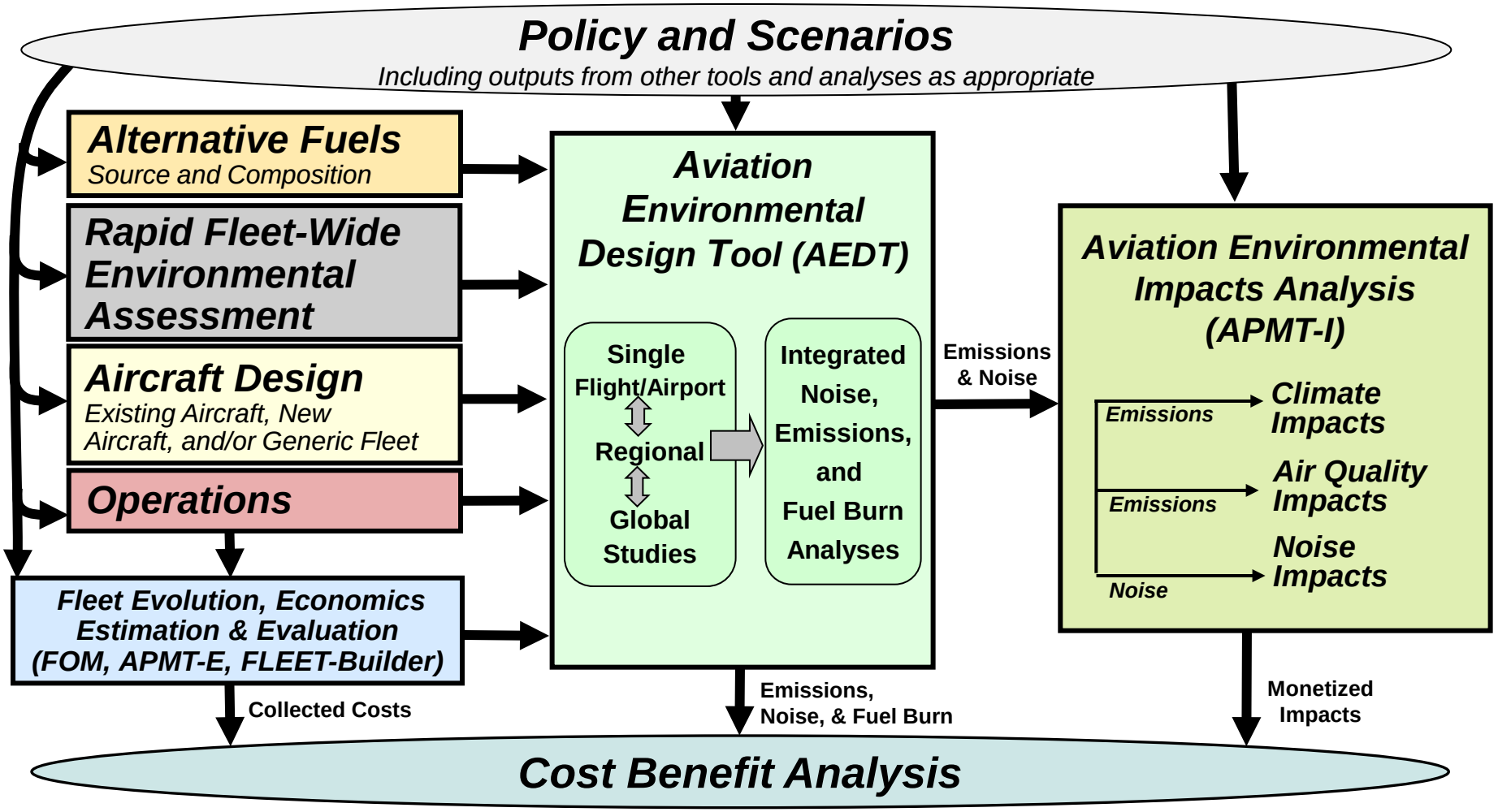
Outline

- Environmental Tools Suite
- AEDT Development Drivers
- AEDT Usage Trends
- AEDT Development
  - AEDT 2b Development Schedule
  - AEDT 2c Development Plan
- AEDT 3+ (FY17+) Development
- Research Supporting AEDT
- Summary

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)



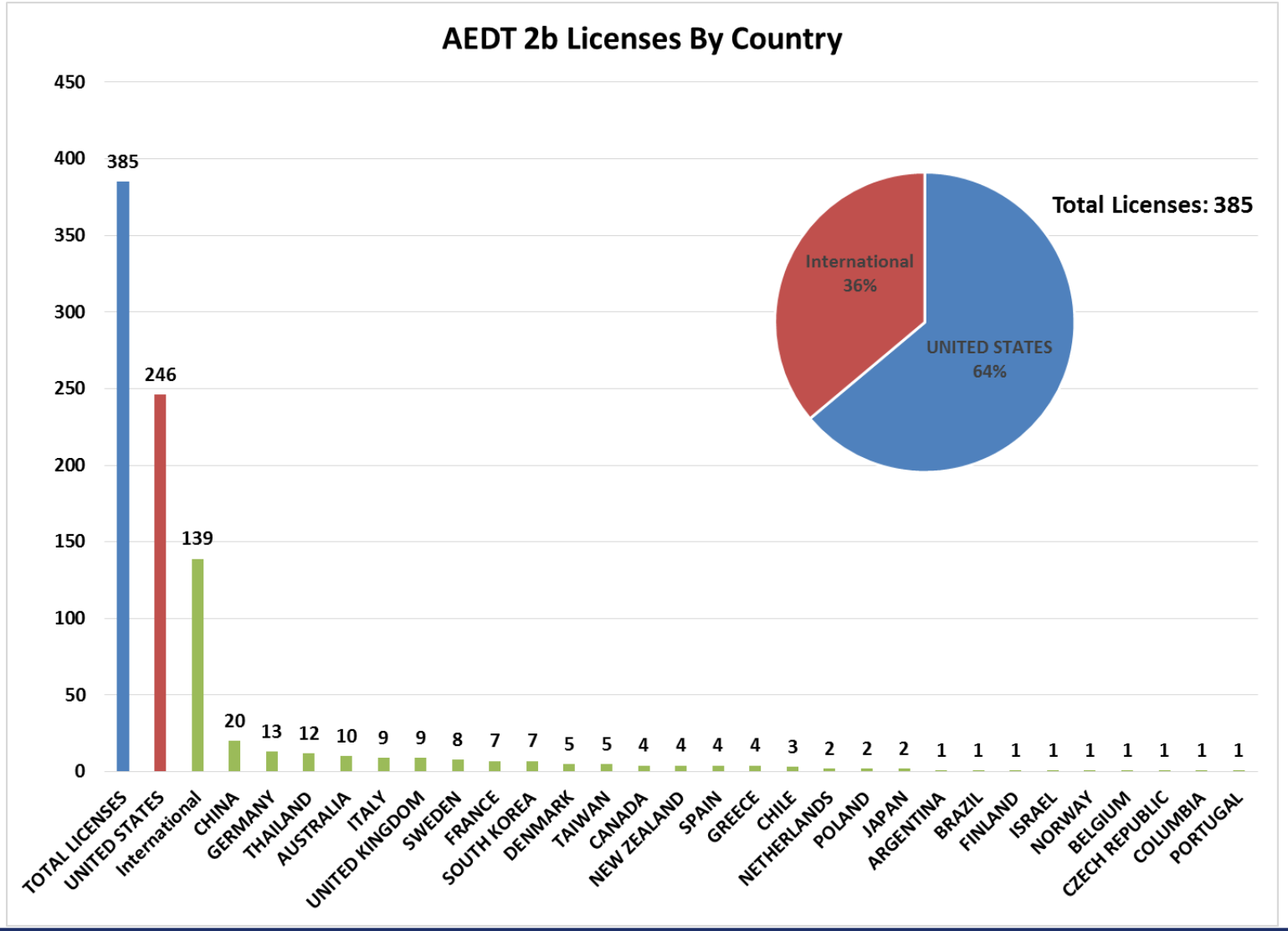
AEDT Development Drivers

We develop tools for specific purposes:

- CAEP analyses
  - Noise
  - Emissions (NO_X, CO_2, and Black Carbon)
  - Global Market Based Measure
- Air space and airport design and planning (e.g., NEPA reviews)
- NextGen analyses
  - Performance reporting (annual basis)
  - Future goals analysis (out to 2050)
  - Assessing benefits of NextGen
- Technology evaluation (e.g., CLEEN Program)

Note this is not an all-inclusive list

AEDT Licenses as of June 2016



AEDT Versioning and Policy

- FAA order 1050.1F requires most current version of AEDT for regulatory environmental impact analyses
- FAA currently updates AEDT more frequently (every three months) than the legacy tools.
  - Allows for the inclusion of concepts derived from active research
  - Some of the updates are major changes affecting the fuel burn, noise and emissions while other updates are bug fixes and usability improvements
- Version changes will only occur with major updates
  - Minor improvements will be included in service pack updates.

AEDT 2 Series Development Schedule

AEDT 2b released May 2015

- **Feature Pack 1 (FP1) (July 2015)**
  - AERMOD/AERMET (2 embedded EPA tools)
  - Fixed dispersion related issues
- **Service Pack 2 (SP2) (December 2015)**
  - Improved interface per customer recommendations
  - Updated reference emissions data
- **Service Pack 3 (June 2016)**
  - Time Audible metric
  - VALE Report workflow improvements

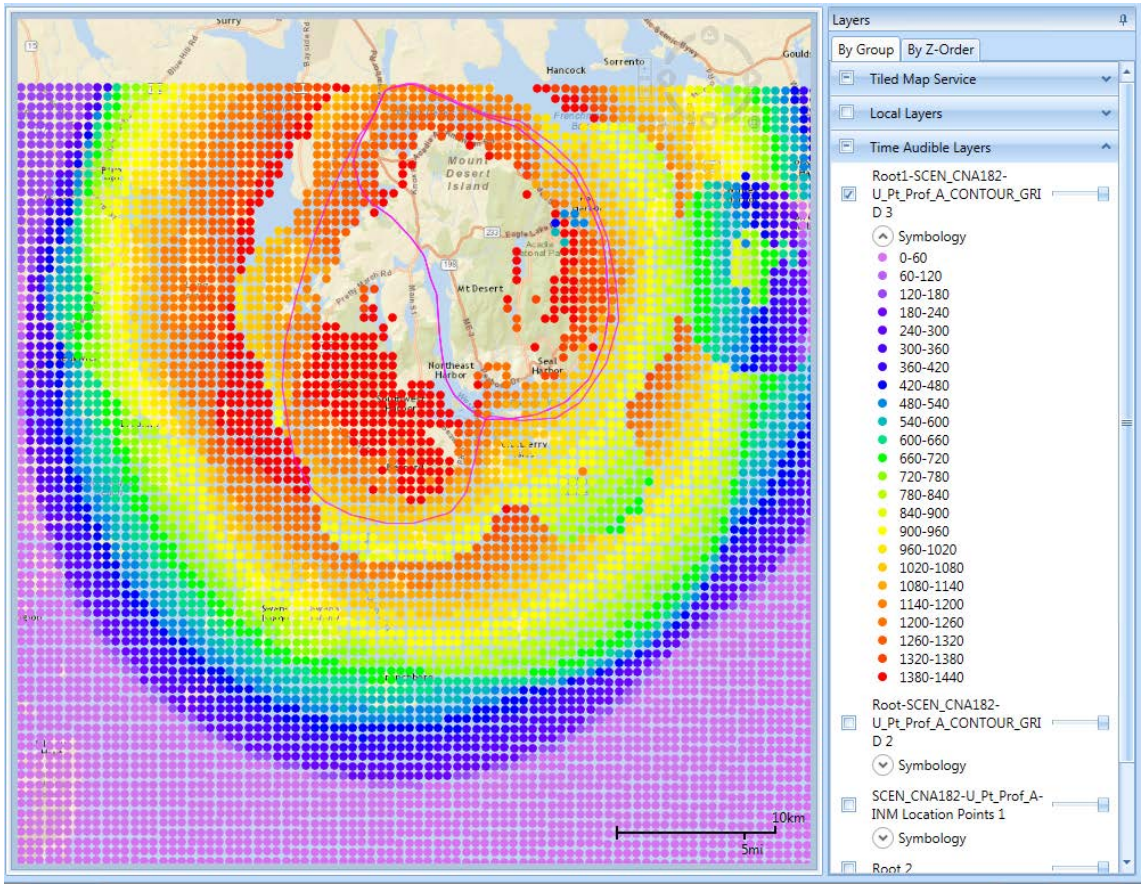
AEDT 2c Scheduled Release September 2016

- **Service Pack 1 (December 2016)**
- **Service Pack 2 (March 2017)**

AEDT 2b Current Status – SP3 (1 of 3)

- **Released June 13, 2016**
- **Major functionality updates:**

- Time Audible:
  - Available by request from FAA
  - Multiple metrics
  - Support for National Park Service (NPS)
  - Includes utilization of boundary files



AEDT 2b Current Status – SP3 (2 of 3)

VALE Report

- Multiple analysis year VALE reporting
- Support for equipment lifetime processing

VALE Report 2010 - 2014

Print Preview

Baseline (Source): 2010-CMAQ

Alternative (Destination): VALE-Scen

Pollutant (Unit): Grams

No.	Year	Scenario	Source Group	CO	VOC	NOx	SOx	PM-10	PM-2.5
			2011 Net ER	***-11,773,439.990***	***-9,300,834.780***	***-47,093,759.760***	***-218,127.630***	***-1,012,300.390***	***-1,012,300.390***
3	2012	2010-CMAQ							
			2010_CMAQ_Washington Dulles International_TrackOps	24,896.490	4,192.950	2,333,036.560	84,361.230	38,778.100	38,778.100
			2010_CMAQ_Washington Dulles International_TrackOps (GSE LTO)	270,490.370	10,047.570	38,903.720	679.740	1,662.590	1,599.360
			2010_CMAQ_Washington Dulles International_TrackOps (APU)	18,569.150	1,340.790	36,335.590	3,752.930	2,307.630	2,307.630
			2010_CMAQ_Washington Dulles International_NonAircraft (Stationary Sources)	11,773,440.000	9,300,834.780	47,093,760.000	210,240.000	1,009,152.000	1,009,152.000
			2010-CMAQ Total	**12,087,396.010**	**9,316,416.090**	**49,502,035.870**	**299,033.900**	**1,051,900.320**	**1,051,837.090**
		VALE-Scen							
			2010_CMAQ_Washington Dulles International_TrackOps	24,896.500	4,192.950	2,333,036.800	76,473.600	35,629.710	35,629.710
			2010_CMAQ_Washington Dulles International_TrackOps (GSE LTO)	270,490.370	10,047.570	38,903.720	679.740	1,662.590	1,599.360
			2010_CMAQ_Washington Dulles International_TrackOps (APU)	18,569.150	1,340.790	36,335.590	3,752.930	2,307.630	2,307.630
			VALE-Scen Total	**313,956.020**	**15,581.310**	**2,408,276.110**	**80,906.270**	**39,599.930**	**39,536.700**
			2012 Net ER	***-11,773,439.990***	***-9,300,834.780***	***-47,093,759.760***	***-218,127.630***	***-1,012,300.390***	***-1,012,300.390***
4	2014	2010-CMAQ							
			2010_CMAQ_Washington Dulles International_TrackOps	24,896.490	4,192.950	2,333,036.560	84,361.230	38,778.100	38,778.100
			2010_CMAQ_Washington Dulles International_TrackOps (GSE LTO)	200,613.440	7,596.740	29,833.790	633.080	1,372.950	1,318.400
			2010_CMAQ_Washington Dulles International_TrackOps (APU)	18,569.150	1,340.790	36,335.590	3,752.930	2,307.630	2,307.630
			2010_CMAQ_Washington Dulles International_NonAircraft (Stationary Sources)	11,773,440.000	9,300,834.780	47,093,760.000	210,240.000	1,009,152.000	1,009,152.000
			2010-CMAQ Total	**12,017,519.080**	**9,313,965.260**	**49,492,965.940**	**298,987.240**	**1,051,610.680**	**1,051,556.130**
		VALE-Scen							
			2010_CMAQ_Washington Dulles International_TrackOps	24,896.500	4,192.950	2,333,036.800	76,473.600	36,623.300	36,623.300
			2010_CMAQ_Washington Dulles International_TrackOps (GSE LTO)	200,613.440	7,596.740	29,833.790	633.080	1,372.950	1,318.400
			2010_CMAQ_Washington Dulles International_TrackOps (APU)	18,569.150	1,340.790	36,335.590	3,752.930	2,307.630	2,307.630
			VALE-Scen Total	**244,079.090**	**13,130.480**	**2,399,206.180**	**80,859.610**	**40,303.880**	**40,249.330**
			2014 Net ER	***-11,773,439.990***	***-9,300,834.780***	***-47,093,759.760***	***-218,127.630***	***-1,011,306.800***	***-1,011,306.800***
		2010-CMAQ		**48,400,762.670**	**37,267,602.930**	**198,014,750.910**	**1,196,482.970**	**4,207,827.360**	**4,207,567.650**
		VALE-Scen		**1,307,002.710**	**64,263.810**	**9,639,711.870**	**323,972.450**	**159,619.390**	**159,359.680**
		Net Change		***-47,093,759.960***	***-37,203,339.120***	***-188,375,039.040***	***-872,510.520***	***-4,048,207.970***	***-4,048,207.970***
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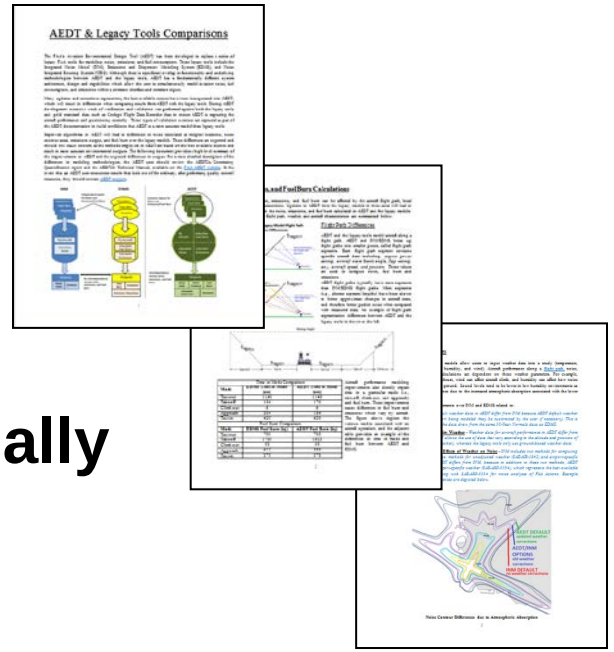
AEDT 2b Current Status – SP3 (3 of 3)

- **Database updates:**
  - Addition of fuel consumption and emissions for military aircraft (and aircraft with thrust type = “other”)
- **Other Updates:**
  - Improvements to the import of EDMS studies
    - Import with inconsistent or missing airport data
  - Improvements to the study upgrade process
    - Supports upgrading studies from version 1.43.1 up to the current version
  - Consolidation of ASIF, EDMS, and INM import into the Import Study wizard
  - 17 Bug fixes

User Support - AEDT Coloring Book

- **Environmental Protection Specialists have struggled understanding and communicating the differences between AEDT and the legacy tools**

- **The Coloring Book provides information in an easy to understand format**



- **The feedback has been exceptionally positive**

User Support - Website

- AEDT Support Website - https://aedt.faa.gov
  - Provides product information
  - Frequently Asked Questions (FAQs) including known issues
  - Optional tools
  - Support feedback
  - Training material – example exercises, instructional videos, etc.

AEDT 2c Development Plan

- **AEDT 2c Scheduled for Release September 2016**
- **Planned work includes**
  - *Full flight non-volatile Particulate Matter (nvPM) mass and number*
  - *Numbers Above Noise Level (NANL) noise metric*
  - *Environmental Justice (EJ) functionality*
  - Altitude controls
  - Sensor path data altitude and speed pathologies
  - Support background emissions concentrations
  - Add ability to edit operations
  - Certification and accreditation of AEDT website
  - Global Mapper License Update for Sept 2016
  - Upgrade to .NET 4.6.1

AEDT 2c Development - nvPM Modeling

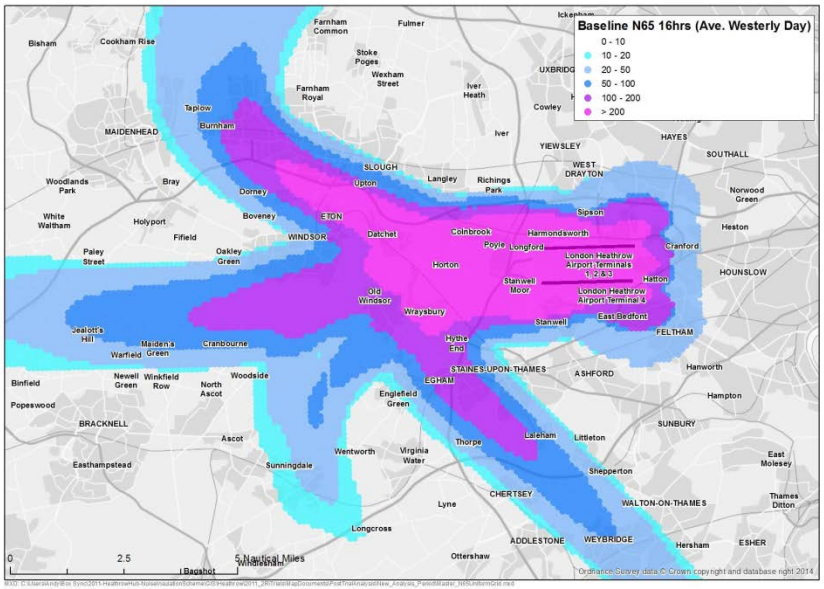
AEDT support in the upcoming nvPM standard setting process

- CAEP/11 assess stringency options
  - Emissions Index (EI) measurements for 23 representative engines
  - Full flight performance based analyses
    - In standard setting process
    - Cost benefit analysis
    - Climate and air quality analyses
- Aerodyne developed a method for estimating nvPM mass and number for full flight
  - Being used primarily for cruise phase of flight
- FOA3.0 and Aerodyne methods
  - Provide a basis for assessing nvPM for all phases of flight

AEDT 2c is implementing a number of methods for estimating nvPM mass and number for all phases of flight

AEDT 2c Development – Number Above Noise Level Metric

- **Number of events above noise level**
  - **LAMAX[1], LCMAX[2], SEL[3]**
  - **Grid points and contours**
  - **Gaining popularity**
  - **Potential supplemental metric for PBN**



Grid Point	DNL (dB)	60dB	65dB	70dB	75dB	80dB	85dB	90DB
1	60	183	123	62	22	10	3	0
2	60	342	236	119	23	3	0	0
3	60	369	268	126	16	2	0	0
4	60	282	227	135	56	9	0	0
5	65	399	328	273	162	58	4	0
6	65	355	305	261	157	65	6	0
7	65	395	361	297	164	43	5	1

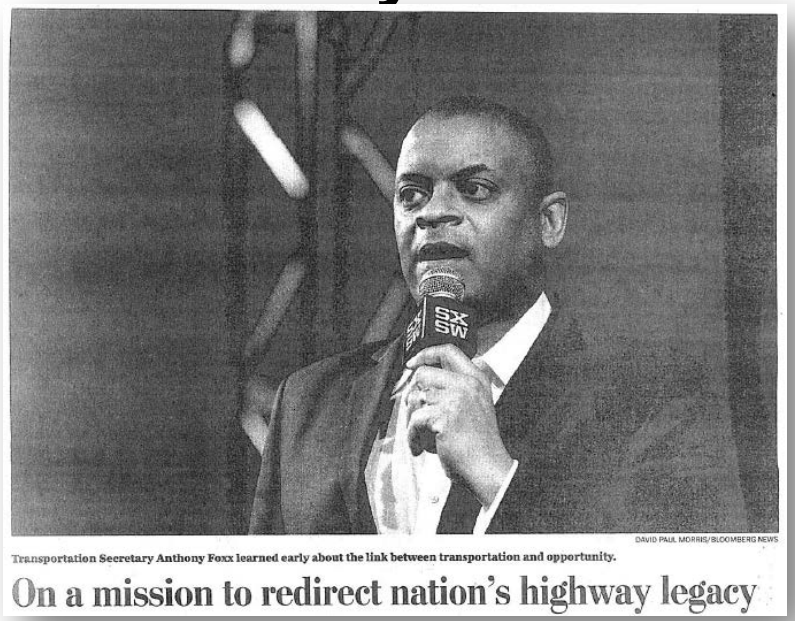
Number-of-Events Above L_{max} 60 -90 dB at Grid Points Located on DNL 60 and 65 dB Contours

[1]LAMAX = Maximum A-weighted Sound Level (dB)
[2]LCMAX = Maximum C-weighted Sound Level (dB)
[3]SEL = Sound Exposure Level (dB)

AEDT 2c Development Plan

Environmental Justice (EJ) functionality

- The Secretary of Transportation is focused on the relationship between transportation infrastructure and minority and low-income communities.



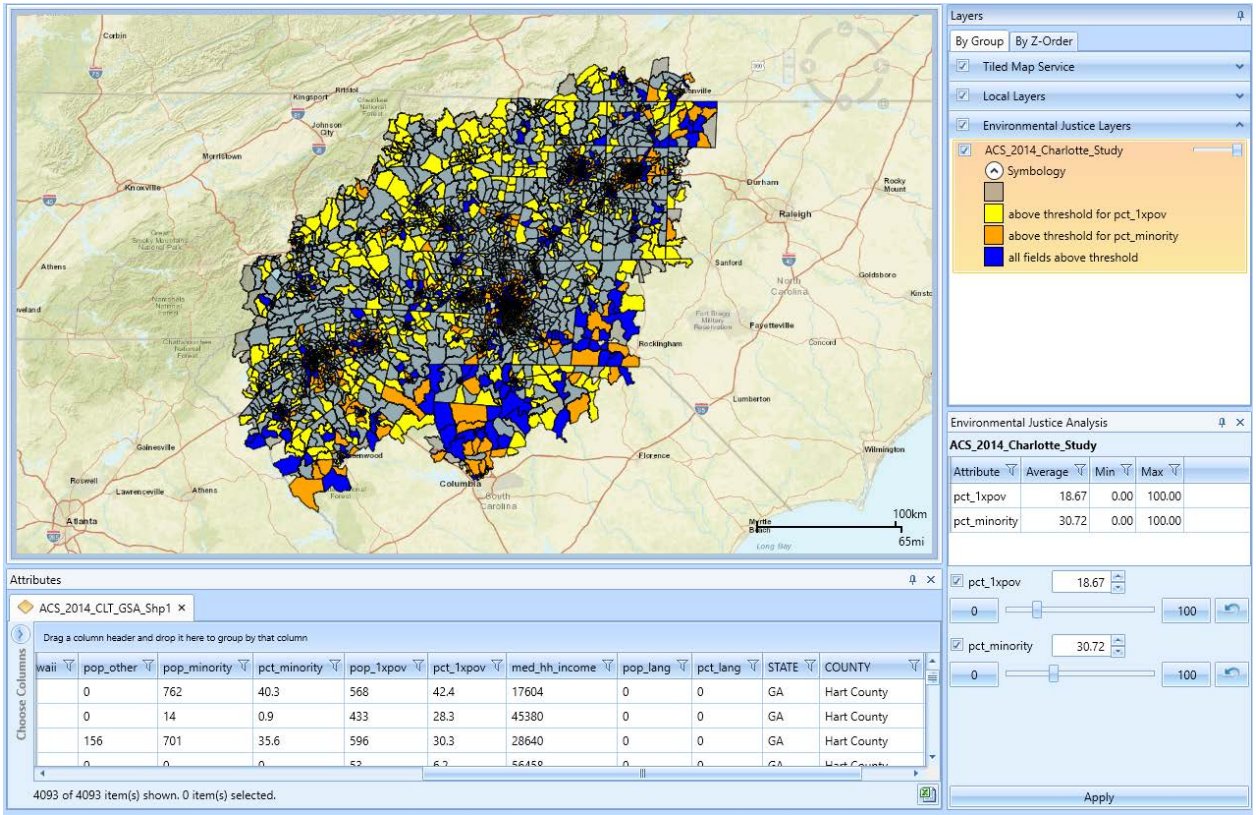
- To support the Secretary's efforts, FAA has committed to:
  - Develop new capability for our environmental assessment tools to address EJ communities

"Transportation secretary aims to right wrongs in poor, minority areas", Washington Post, March 29, 2016

AEDT 2c Development Plan

Environmental Justice functionality

- Assists in the identification of potential EJ populations for meaningful outreach
- EJ defined by minority and low income populations based on US Census data
- AEE will issue guidance on use of EJ functionality
- Plans are in place to extend the TARGETS integration efforts to include the EJ functionality

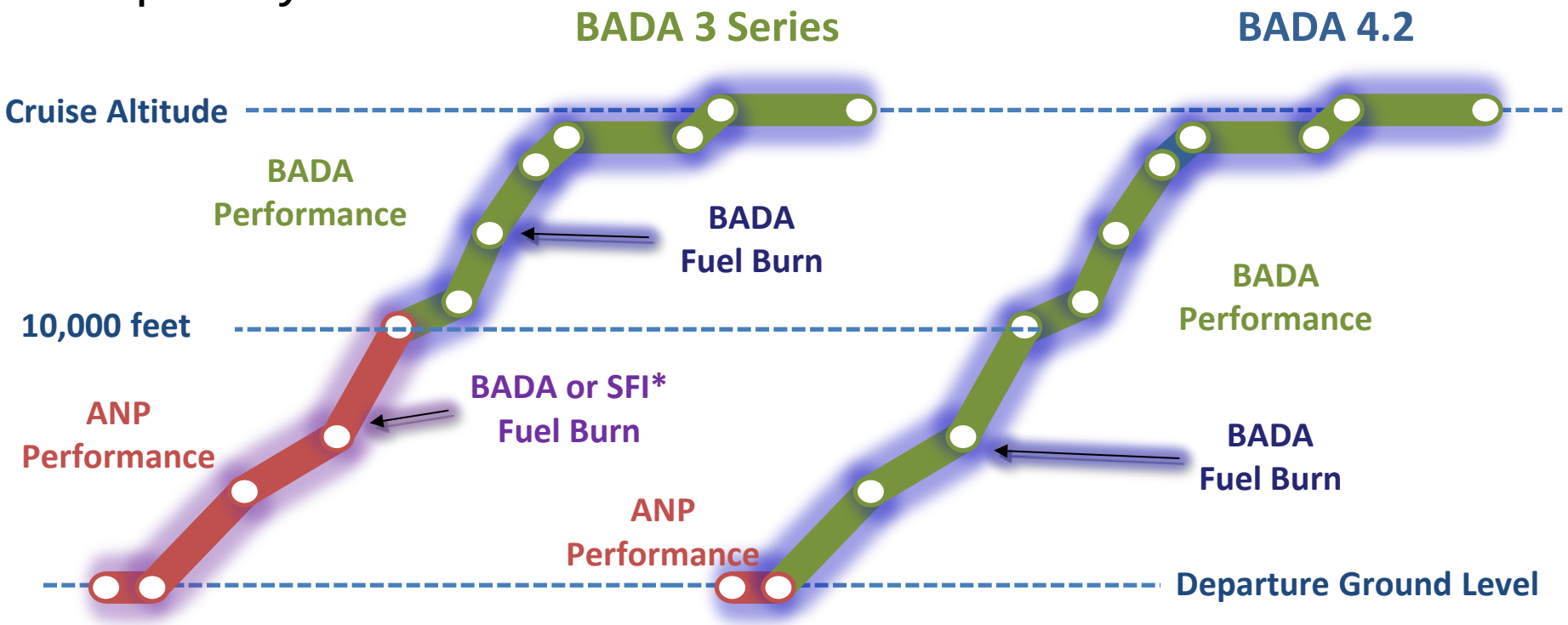


AEDT 2c Development Plan – SP1 and SP2

- **AEDT 2c SP1 and SP2 Scheduled for Release in December 2016 and March 2017**
- **Planned work includes**
  - *High-Fidelity Weather*
  - *Sensor path smoothing*
  - Dynamic grid for dB and non-dB metrics
  - AERMOD model upgrade
  - Detailed grid (legacy noise functionality)
  - Generate a contour for point-type receptors
  - Clipping contours based on boundaries
  - AERMOD complex terrain modeling
  - MOVES Improvements
  - Continue bug fixes, usability improvements

Incorporating BADA4 within AEDT

- Update performance module to BADA 4.2 (limited use)
  - Represents most accurate dataset
  - Replaces ANP data up to ground roll
- Development will include addition of sensor path modeling capability



* Senzig, Fleming, Iovinelli Method

AEDT 3+ Development (FY17+)

- **Functionality**
  - Focus will be on Aircraft Performance Module (APM)
  - APM workshop feedback
  - May include some noise and emission functionality
- **Usability**
  - Data Input
  - Distributed Computing
  - GIS Platform

AEDT 3+ Development – Functionality (1 of 3)

- **APM Taxiway Modeling**
  - Develop a taxiway “drive cycle” that better accounts for idle, acceleration, and ground roll
  - Include taxiway noise modeling (based on ACRP 02-27) and improved taxiway emissions modeling (based on ACRP 02-45)
- **APM Takeoff Weight Estimation**
  - Improve takeoff weight estimation using load factor (ASCENT P35, ACRP 02-55)
- **APM Approach Modeling**
  - Improve approach modeling to include aircraft configuration variations and augment noise-power-distance curves to account for airframe configuration changes (ASCENT P23, ACRP 02-55) speed brakes

AEDT 3+ Development – Functionality (2 of 3)

- **APM Reduced Thrust Takeoff**
  - Develop more realistic takeoff thrust model based on actual practice of using reduced thrust. (ACRP 02-27).
- **APM Performance Algorithm Improvements**
  - Explore new algorithms to improve helicopter modeling and introduce new aircraft types (drones, supersonics, advanced aircraft (e.g. NASA N+3)

AEDT 3+ Development – Functionality (3 of 3)

Noise and Emissions

- Improve aircraft substitution method to optimize noise and emissions/fuel modeling.
- Updates to allow the use of latest Department of Defense (DoD) noise model input/output, similar to previous INM/NoiseMap integration, for better modeling of military aircraft and more harmonization with DoD analyses
- Drive both noise and emissions modules with identical high-fidelity weather inputs (e.g., MERRA2)
- Adapt AEDT to enable use of WRF-based inputs (provides consistency with CMAQ)

AEDT 3+ Development – Usability

- **GIS software alternatives to ESRI**
  - Explore the possibility of using open source GIS software
- **Cloud Computing, Web Services, Computational Efficiencies**
  - Distributed or grid computing for improving computational efficiencies
  - Utilize cloud computing to address computational resources
  - Cloud for large data storage and sharing
  - Web services - Users would use as a web service to access/run scenarios

Research to Support AEDT 3+ APM Development

- **A35: Airline flight data examination to improve flight performance modeling**
  - Evaluate and identify improvement in aircraft performance modeling capabilities of AEDT
  - Develop sets of reduced data from airline aircraft flight data for validation of AEDT.
- **A45: Takeoff/Climb Analysis to Support AEDT APM Development**
  - Conduct a comprehensive statistical analysis of airline aircraft flight data to develop alternative weight estimators and thrust levels
- **A46: Surface Analysis to Support AEDT APM Development**
  - Identify and evaluate methods for improving taxi performance modeling in AEDT that better accounts for aircraft thrust profiles during taxi.

Research to Support AEDT 3+ Noise Development

- **A5: Noise emission and propagation modeling**
  - investigate the effect of met conditions on noise propagation
  - consider effect of source motion, long distance propagation and weather effects
- **A23: Analytical Approach for Quantifying Noise from Advanced Ops Procedures**
  - Conduct an assessment of gaps in current noise modeling tools
  - Explore approaches for modeling noise due to configuration changes
- **A43: Noise Power Distance Re-evaluation**
  - Identify and evaluate possible improvements to the existing NPD method that can capture aircraft configuration, speed, and thrust

Summary

- **AEDT's agile development allows for more rapid response to user needs**
  - EJ implementation in AEDT 2c
  - Number Above Noise Level (NANL) functionality
- **Ongoing development**
  - User interface improvements
  - Expansion of functionality and external tools integration
  - Support for ongoing and upcoming FAA research and international policy analyses
- **AEDT future development will focus on aircraft performance and expanded functionality**
  - Improved accuracy of aircraft position and performance
  - Implementation of current research results and recommendations
  - Support of cloud computing solutions