Development Update: The FAA's Aviation Environmental Design Tool (AEDT)

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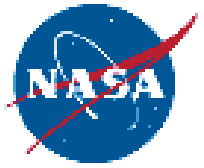
U.S. Department of Transportation
Research and Innovative Technology Administration

AEDT Development Team



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Outline

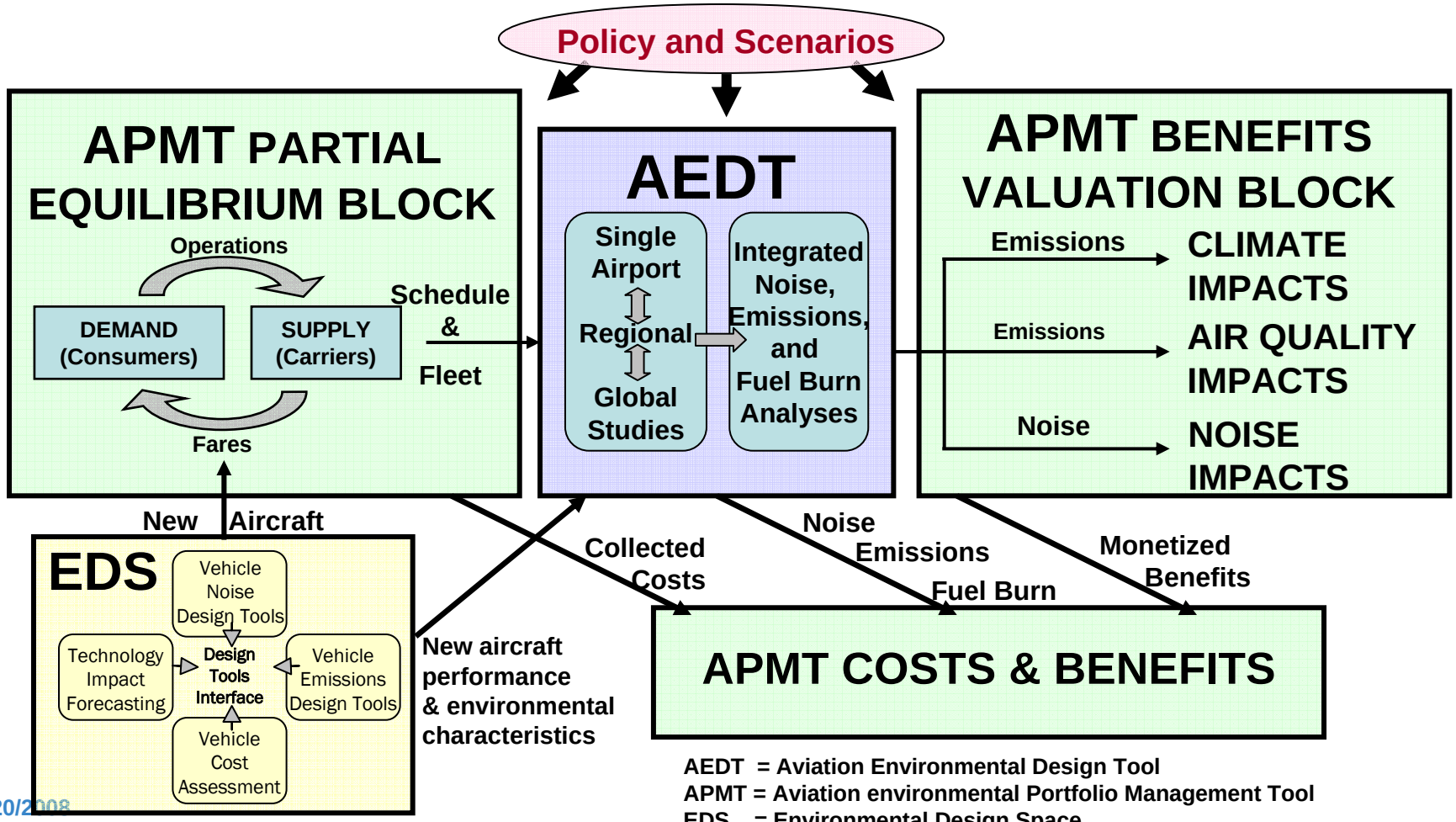
- What is AEDT? (recap)
- What does AEDT mean for my airport?
- Users of AEDT
- Capability Demonstrations
- Development Timeline
- Current State of AEDT and Legacy Tools
- Assessment
- Next Steps

What is AEDT?

- Single, Integrated Aviation Environmental Tool
- Scale
  - Global / National / Regional / Local
  - Noise / Emissions / Fuel Burn
- Interdependencies / Tradeoffs

- Future Technologies (EDS)
- Integrated Economic Analysis (APMT)

AEDT as part of FAA/AEE Tools Suite



AEDT = Aviation Environmental Design Tool
APMT = Aviation environmental Portfolio Management Tool
EDS = Environmental Design Space

What AEDT means for Airports

AEDT *will replace* the following Models:

- Integrated Noise Model - INM
- Emissions and Dispersion Modeling System - EDMS
- Noise Integrated Routing System - NIRS

What AEDT means for Airports (cont)

- Streamlined / improved
  - Data input processes
  - Analysis capabilities
- Tool that meets all needs
  - Regulatory
  - User expectations
  - Public expectations

- More consistent noise & emissions analyses
- Cost savings re defining model scenarios
- Easier / more effective communication with stakeholders

Uses of FAA/AEE Tools Suite

inputs

Policy scenarios
- Certification stringency
- Market-based measures
- Land-use controls
- Sound insulation
- Simulation model output

Market scenarios
- Demand
- Fuel prices
- Fleet

Environmental scenarios
- CO_2 growth
- Noise abatement procedures

Technology and operational advances
- CNS/ATM, NGATS
- Radar data
- Long term technology forecasts

New Tools Suite

outputs

Cost-effectiveness
- $/kg NOx reduced
- $/# people removed from 65dB DNL
- $/kg PM reduced
- $/kg CO_2 reduced

Benefit-cost
- Health and welfare impacts
- Change in societal welfare ($)

Distributional analyses
- Who benefits, who pays
- Consumers
- Airports
- Airlines
- Manufacturers
- People impacted by noise and pollution
- Special groups
- Geographical regions

Single Airport ⇔ Regional ⇔ Global

AEDT Users

EDMS and INM

- >> 1000 users worldwide
- Environmental analyses, e.g., EIS, Part 150s, etc.
- AEDT Design Review Group (DRG)

SAGE and MAGENTA

- FAA and development team primary users
- Support ICAO/CAEP and JPDO analyses

NIRS

- Regional airspace redesigns

INM – Integrated Noise Model

EDMS – Emissions and Dispersion Modeling System

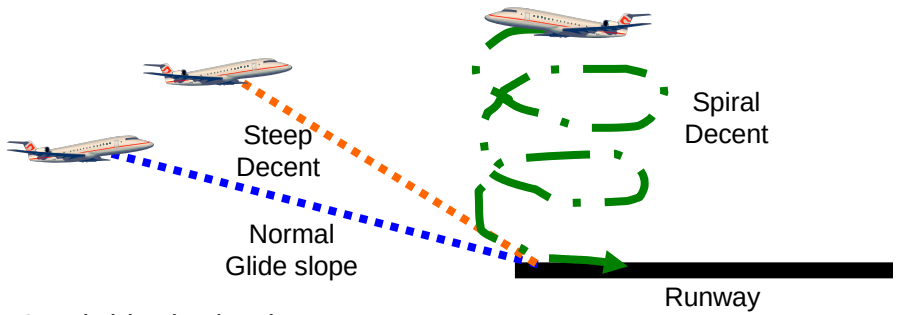
MAGENTA - Model for Assessing Global Exposure from Noise of Transport Airplanes

SAGE – System for assessing Aviation's Global Emissions

AEDT Users (cont.)

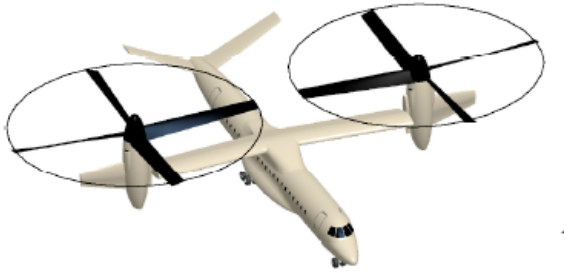
NASA "Advanced Vehicle Concepts and Implications for NextGen" Research Areas (NRA)

- Very Light Jets (VLJ), Tiltrotors, Cruise Efficient Short Take-Off and Landing aircraft (CESTOL), Supersonic Transport (SST), Unmanned Aerial Vehicles (UAS)
- AEDT used for advanced aircraft and operations modeling



N+1 Conventional

N+2 Hybrid Wing/Body

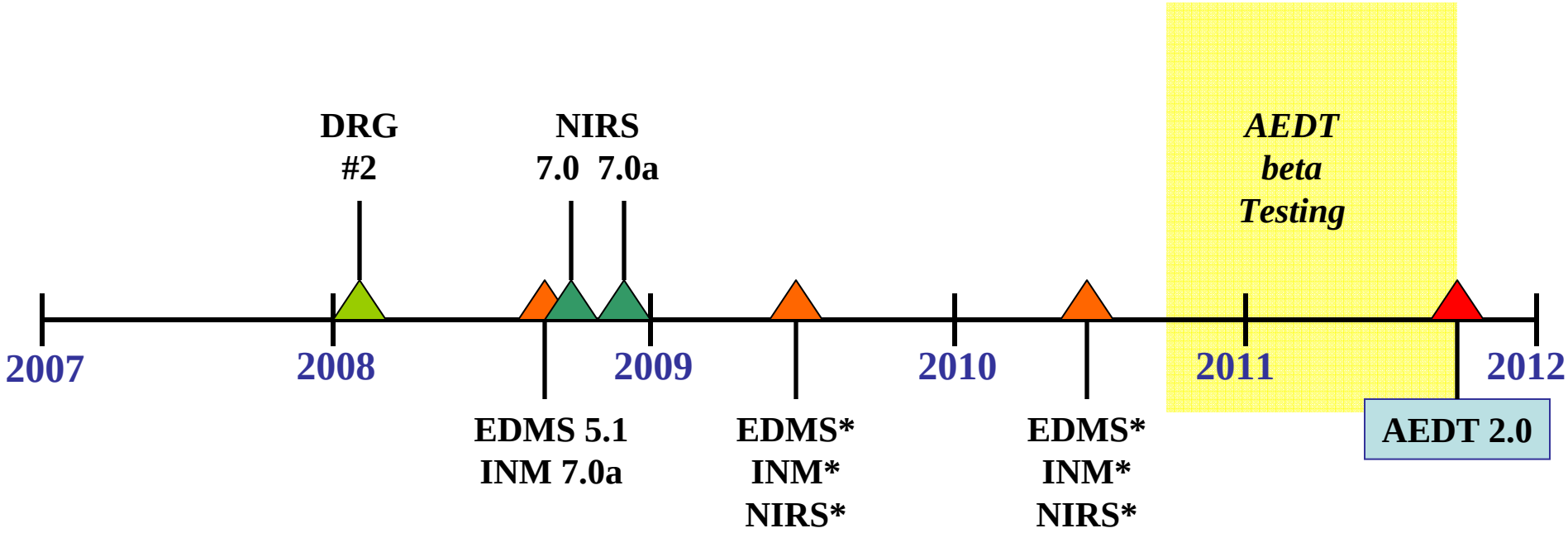


INM and EDMS Releases

- September 2008 releases
  1. INM Version 7.0a
     A. 1st Very Light Jet: Eclipse
     B. Minor bug fixes
  2. EDMS Version 5.1
     A. Hazardous Air Pollutants (HAPs) emissions
     B. Minor bug fixes
- Annual releases *as required* until AEDT 2.0 in 2011
  1. Significant bug fixes
  2. Database updates
  3. Significant computational advancements

http://www.faa.gov/about/office_org/headquarters_offices/aep/models/

Development Timeline

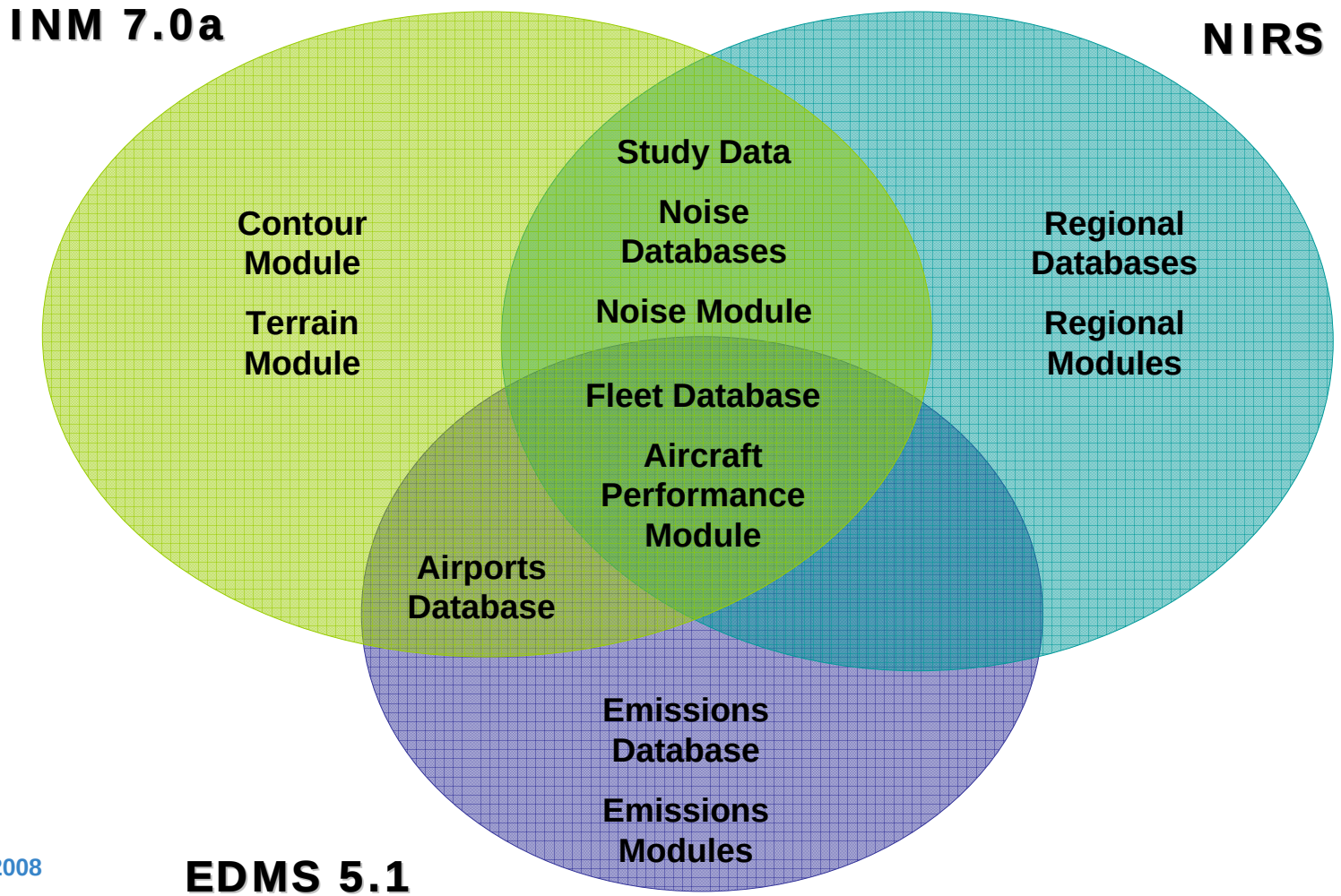


* Releases as needed

DRG meetings 1-2 times per year, as needed

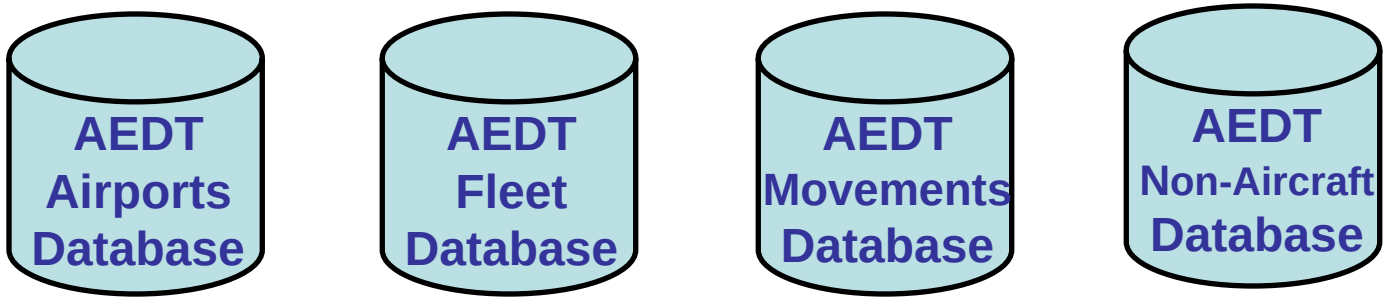
AEDT Newsletters as needed

Current State – Legacy Models



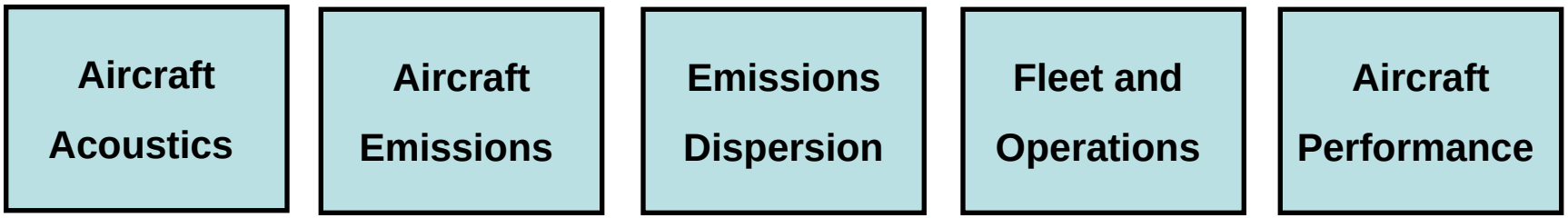
Current State – AEDT Databases

- Redesigned database structure to support all legacy tools (i.e., INM, EDMS, NIRS, MAGENTA & SAGE)
- Data harmonized across legacy tools
- Harmonization with available international sources

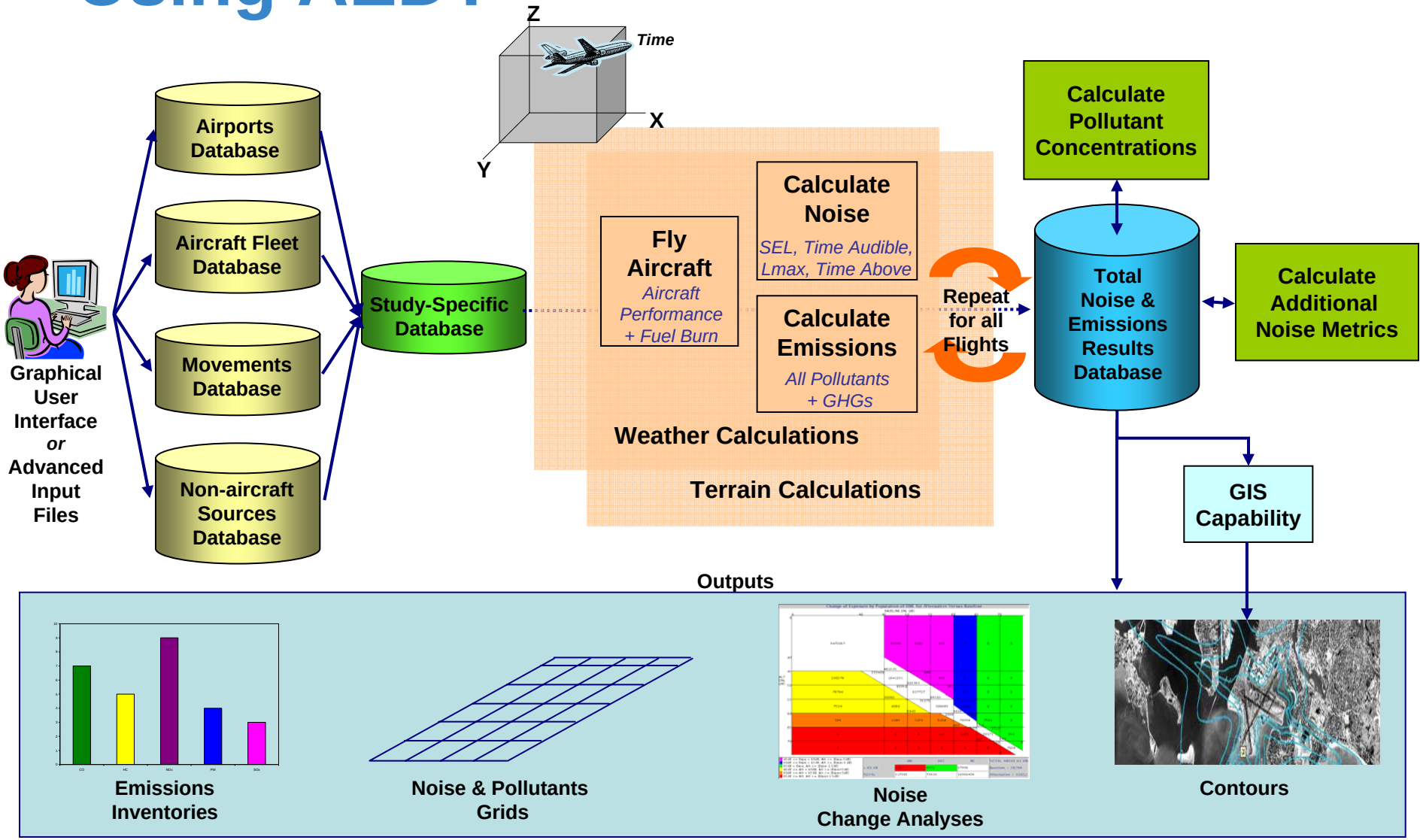


Current State – AEDT Modules

- Redesigned computational modules, e.g., emissions, aircraft performance
- Noise and emissions analyses utilize harmonized, integrated, common modules

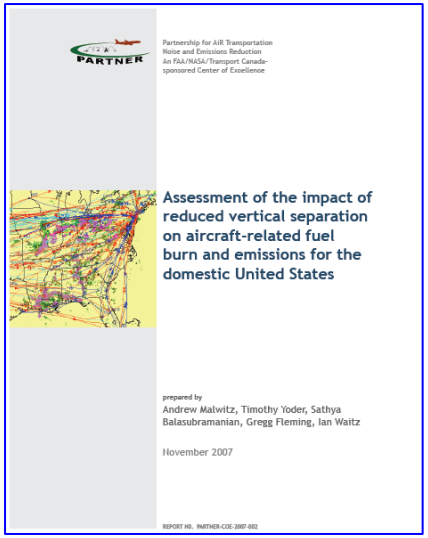


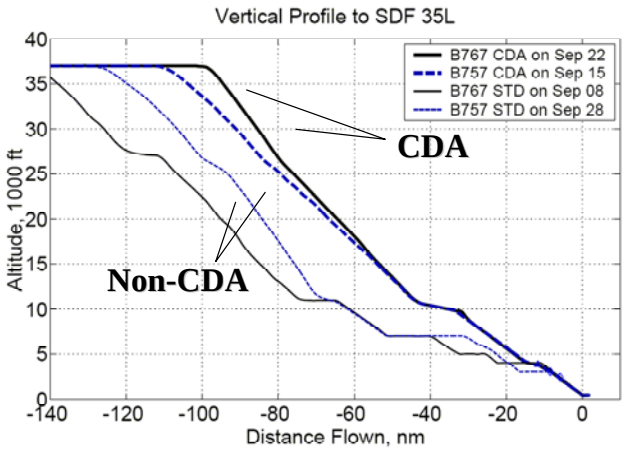
Using AEDT


Z
Time
X
Y
Airports Database
Aircraft Fleet Database
Movements Database
Non-aircraft Sources Database
Graphical User Interface or Advanced Input Files
Study-Specific Database
Fly Aircraft
Aircraft Performance + Fuel Burn
Calculate Noise
SEL, Time Audible, Lmax, Time Above
Calculate Emissions
All Pollutants + GHGs
Repeat for all Flights
Weather Calculations
Terrain Calculations
Calculate Pollutant Concentrations
Total Noise & Emissions Results Database
Calculate Additional Noise Metrics
GIS Capability
Outputs
Emissions Inventories
Noise & Pollutants Grids
Noise Change Analyses
Contours

AEDT Capability Demonstrations

- ICAO/CAEP
  1. Global NOx Stringency
  2. Environmental Trends Assessment
  3. Local Air Quality Assessment
- Continuous Descent Approach (CDA)
- Reduced Vertical Separation Minimum (RVSM)
- Military Airspace Openings Analysis
- Atlantic Interoperability Initiative to Reduce Emissions (AIRE)



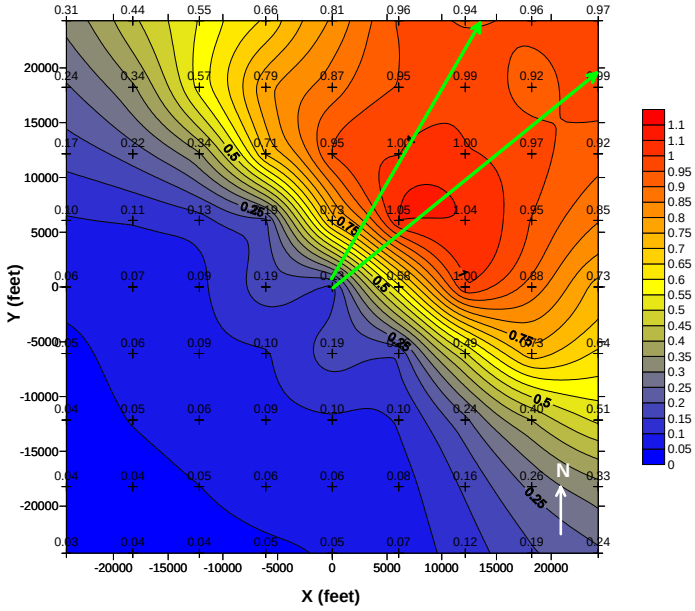


AEDT Assessment

GOAL: Environmental analyses are informed with the associated uncertainty from the tools, inputs and assumptions used in the analysis process

Four-part Approach:

- Parametric sensitivity and uncertainty analyses
- Comparisons to Gold Standard data
- Expert reviews (DRG, ICAO CAEP, IRG, SAE A-21, …)
- Capability Demonstrations and Sample Problems



AEDT Assessment

Parametric sensitivity and uncertainty analyses

- Module Level Assessment - *core modules, done individually*
  1. Assessment Questions (AQs)
  2. Documentation of Assumptions and Limitations (DAL)
  3. Assessment Plan
  4. Assessment Report
- System Level Assessment

Monte Carlo simulations
Global Sensitivity Analyses
Distribution Sensitivity Analyses
Surrogate Models

Next Steps

- Analysis
    1. JPDO analysis support
    2. Migrating JPDO Systems Modeling and Analysis Division's Analyses to AEDT
    3. Continue Module- and System-level Assessment
    4. ICAO/CAEP model evaluation and acceptance process, sample problems and analyses
- Development
    1. Continue database harmonization process
    2. Continue migration of modules to .NET environment
    3. Web-based query tool migrating to full application (limited availability)
    4. Integrated graphical user interface (GUI); developed and coordinated with design review group (publicly available)

Questions / Discussion

FAA Environmental Tools web site:
http://www.faa.gov/about/office_org/headquarters_offices/aep/models/

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Acronyms

AEDT – Aviation Environmental Design Tool
APMT – Aviation environmental Portfolio Management Tool
CAEP – Committee for Aviation Environmental Protection
BADA – Base of Aircraft Data
CDA – Continuous Descent Arrival
CESTOL - Cruise Efficient Short Take-Off and Landing aircraft
DRG – Design Review Group
EDMS – Emissions and Dispersion Modeling System
EDS – Environmental Design Space
EIS – Environmental Impact Statement
EPA – Environmental Protection Agency
FAA – Federal Aviation Administration
GHG – Greenhouse gas
GUI – Graphical User Interface
ICAO – International Civil Aviation Administration
ICD – Interface Control Document
INM – Integrated Noise Model
JPDO – NextGen Joint Planning and Development Office
MAGENTA – Model for Assessing Global Exposure from Noise of Transport Airplanes
NASA – National Aeronautics and Space Administration
.NET – Microsoft framework
NIRS – Noise Integrated Routing System
NOx – Nitrogen Oxides
SAE, A-21 – Society of Automotive Engineers, Aircraft Noise and Emissions Modeling Committee
SAGE – System for assessing Aviation's Global Emissions
SST - Supersonic Transport
UAS - Unmanned Aerial Vehicles
VLJ - Very Light Jets