



Federal Aviation Administration



Research to Reality in Air Traffic Management

FAA EDMS Airport Air Quality Model Development

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EDMS Project Manager

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Introduction

- ◆ Required Model
- ◆ Aviation Sources
 - ❖ Aircraft
 - ❖ APUs (Auxiliary Power Units)
 - ❖ GSE (Ground Support Equipment)
- ◆ Non-aviation Sources
 - ❖ Power Plants, Fuel Tanks
 - ❖ Roadways, Parking Facilities



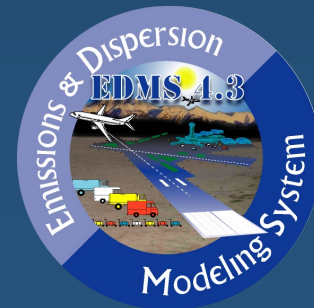
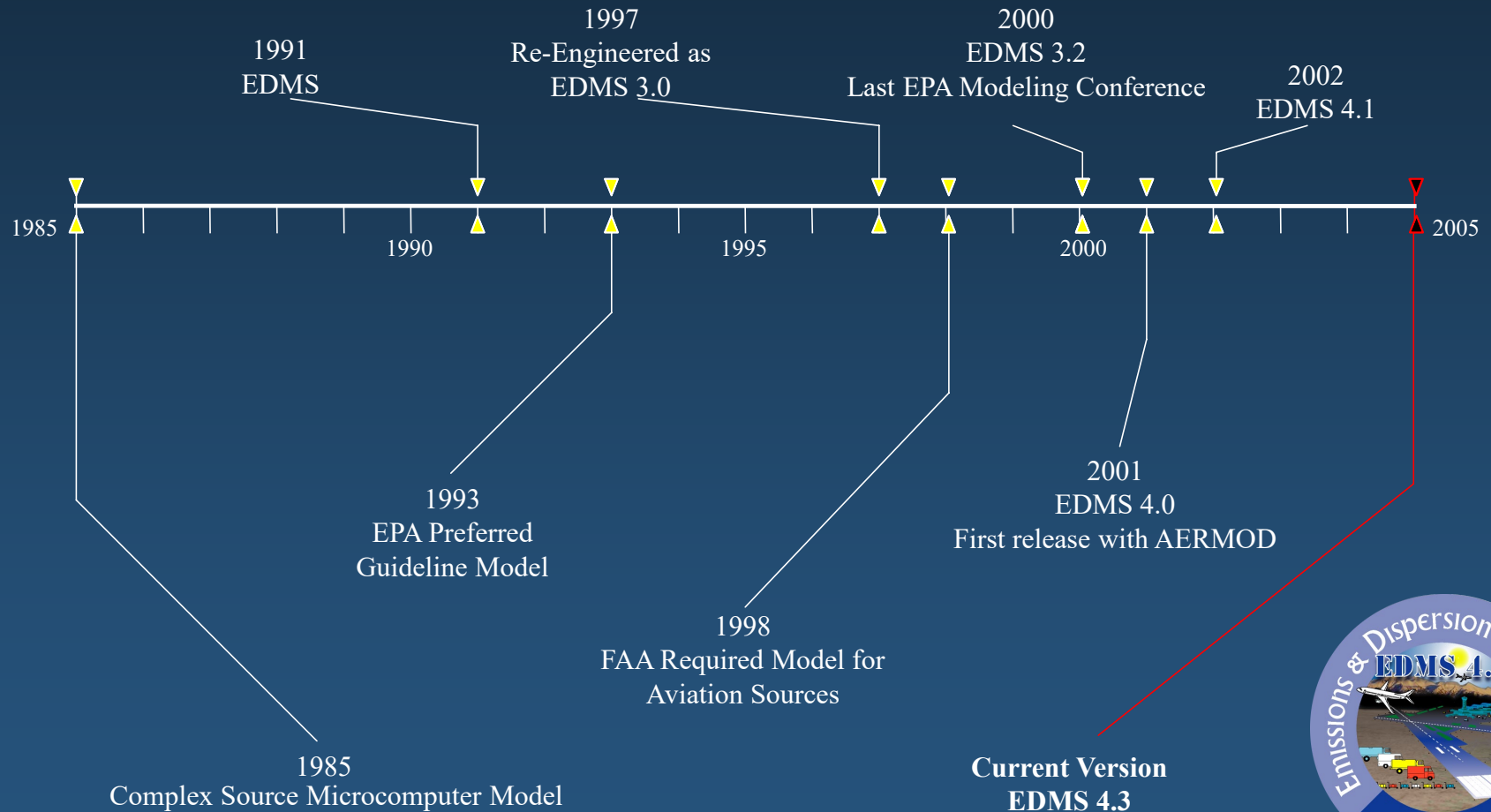
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History



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Emissions Inventories

- ♦ Data Sources
 - ❖ ICAO Databank
 - ❖ MOBILE
 - ❖ NONROAD
 - ❖ AP-42
- ♦ User Input Requirements
 - ❖ Aircraft fleet ops, taxi/queue times, etc...
 - ❖ Traffic levels, parking lot throughput
 - ❖ Stationary Source operations



Dispersion Analyses

- ♦ User Input Airport Layout
 - ❖ Gates, Taxiways, Queues, Runways, etc...
- ♦ AERMOD
 - ❖ AERMIC (AMS/EPA)
- ♦ AERMET
 - ❖ Historical Meteorological Data Processor
- ♦ AERMAP
 - ❖ Terrain Preprocessor



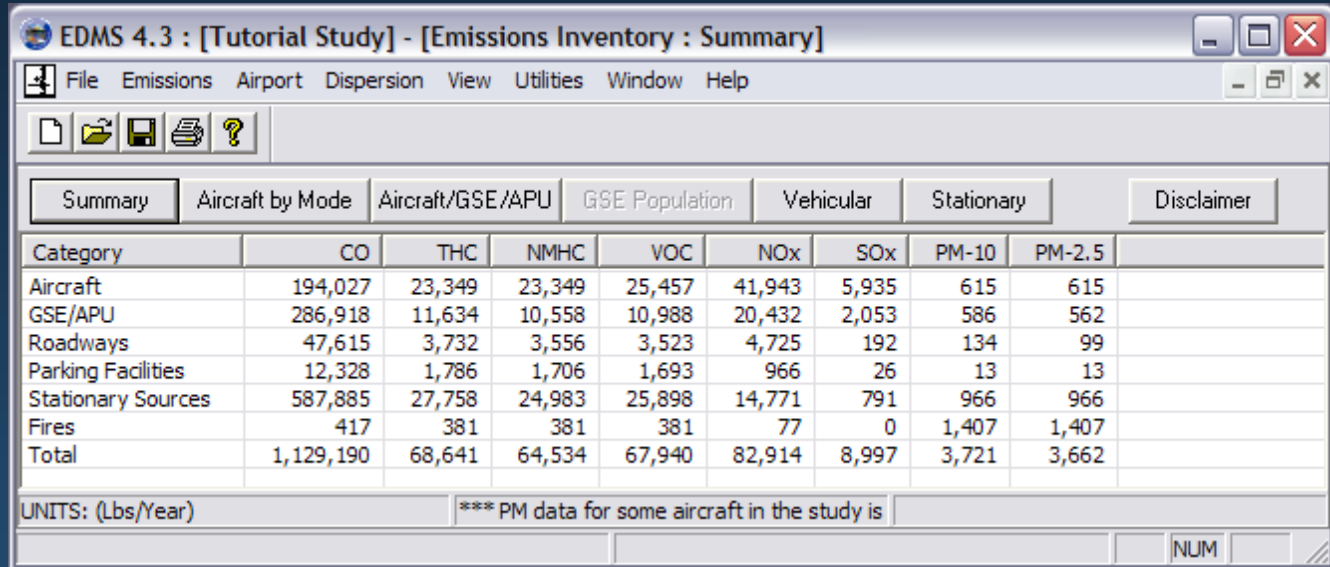
Recent Developments

- ♦ Expanded Pollutant Reporting
- ♦ Database Repair
- ♦ Aircraft Times in Mode
- ♦ GSE Modeling Enhancements
- ♦ Direct interface to MOBILE 5a, 5b and 6.2
- ♦ Parking Facility Modeling
- ♦ Roadway and Taxiway Modeling
- ♦ Stationary Source Modeling
- ♦ Dispersion Modeling Enhancements



Expanded Pollutant Reporting

- Expands the list {CO, THC, NO_x, SO_x, PM₁₀} to include {VOC, NMHC, PM_{2.5}}



EDMS 4.3 : [Tutorial Study] - [Emissions Inventory : Summary]

File Emissions Airport Dispersion View Utilities Window Help

Summary Aircraft by Mode Aircraft/GSE/APU GSE Population Vehicular Stationary Disclaimer

Category	CO	THC	NMHC	VOC	NO _x	SO _x	PM-10	PM-2.5
Aircraft	194,027	23,349	23,349	25,457	41,943	5,935	615	615
GSE/APU	286,918	11,634	10,558	10,988	20,432	2,053	586	562
Roadways	47,615	3,732	3,556	3,523	4,725	192	134	99
Parking Facilities	12,328	1,786	1,706	1,693	966	26	13	13
Stationary Sources	587,885	27,758	24,983	25,898	14,771	791	966	966
Fires	417	381	381	381	77	0	1,407	1,407
Total	1,129,190	68,641	64,534	67,940	82,914	8,997	3,721	3,662

UNITS: (Lbs/Year) *** PM data for some aircraft in the study is

NUM

- Users specify the reporting units of their choice:
 - metric tons / short tons
 - kilograms / pounds
- Smaller units provide a better level of resolution to users with smaller studies
- Metric units provide greater utility to international users



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Database Repair

- EDMS detects data file corruption upon opening a study
- The data can usually be recovered because system crashes usually only affect the file header and NOT the data

BYTES	DESCRIPTION
00	FoxBase+, FoxPro, dBaseIII+, dBaseIV, no memo - 0x03 FoxBase+, dBaseIII+ with memo - 0x83 FoxPro with memo - 0xF5 dBaseIV with memo - 0xB3 dBaseIV with SQL Table - 0xE
01-03	Last update, format YYYYXXDD **correction: it is YYXXDD**
04-07	Number of records in file (32-bit number)
08-09	Number of bytes in header (16-bit number)
10-11	Number of bytes in record (16-bit number)
12-13	Reserved, fill with 0x00
14	dBaseIV flag, incomplete transaction Begin Transaction sets it to 0x01 End Transaction or RollBack reset it to 0x00
15	Encryption flag, encrypted 0x01 else 0x00 Changing the flag does not encrypt or decrypt the records
16-27	dBaseIV multi-user environment use
28	Production index exists - 0x01 else 0x00
29	dBaseIV language driver ID
30-31	Reserved fill with 0x00
32-n	Field Descriptor array
not	Header Record Terminator - 0x00



Aircraft Times in Mode

- ♦ Methodologies
 - ❖ USEPA/ICAO definitions
 - ❖ SAE AIR 1845 Performance based
- ♦ EDMS 3 used the USEPA/ICAO definitions exclusively
- ♦ EDMS 4.0 & 4.1 used the performance based exclusively
- ♦ EDMS 4.2 and 4.3 provide users with a choice
- ♦ EDMS 4.2 and 4.3 include default taxi times from ASPM historical data

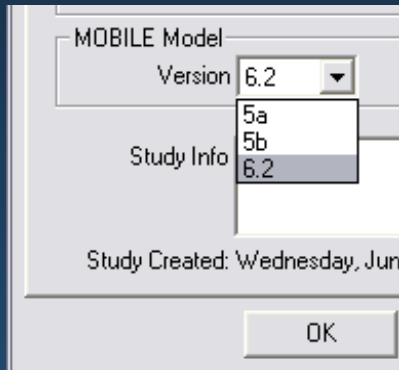


GSE Modeling Enhancements

- ♦ Deterioration Factors
 - ❖ Draft NONROAD 2004 deterioration factors based on year of manufacture
 - ❖ Fleet averages from the draft 2002 NONROAD used when the age is not specified or data is unavailable
- ♦ Studies with custom GSE assignments can easily revert to the default assignments



MOBILE 5a, 5b and 6.2



- ♦ As with aircraft TIM, user's are given a model choice
- ♦ Static lookup table replaced with bundled models which dynamically compute emission factors
- ♦ MOBILE6.2 allows users to specify vehicle type
- ♦ Applies to both Parking Facilities and Roadways



Parking Facility Modeling

- ◆ Users can model multi-level parking garages
- ◆ Users specify:
 - ❖ number of levels
 - ❖ vertical spacing between levels
- ◆ EDMS uses vertically stacked AERMOD area sources



Roadways & Taxiways

- ♦ EDMS 4.0 and 4.1 hard-coded the widths of all roadways and taxiways at 20 meters
- ♦ In EDMS 4.2 and 4.3, users can specify the width of roadways and taxiways
- ♦ The ability to override the default width provides the users with improved dispersion modeling accuracy



Stationary Sources

- ♦ Consistency with *Air Quality Procedures for Civilian Airports and Air Force Bases* (The Air Quality Handbook) for all 9 categories:
 - ❖ Boiler/Space Heaters
 - ❖ Emergency Generators
 - ❖ Incinerators
 - ❖ Aircraft Engine Testing
 - ❖ Fuel Tanks
 - ❖ Surface Coating/Painting
 - ❖ Deicing Areas
 - ❖ Solvent Degreasers
 - ❖ Sand/Salt Piles
- ♦ AERMOD source type specified by the user:
 - ❖ POINT, VOLUME or AREA



Dispersion Enhancements

- ♦ AERMOD build 02222 with:
 - ❖ PRIME plume rise
 - ❖ Building downwash
- ♦ New AERMOD wizard

AERMOD: Step 4. Output Reporting

Output File(s) Base Name:

☐ Automatically run AERMOD after input file generation

High Values by Receptor	1st	2nd	3rd	4th	5th	6th	Maximum Values	All Values
All Periods	☐	☐	☐	☐	☐	☐	0	☐
1 Hour	☐	☐	☐	☐	☐	☐	0	☐
2 Hour	☐	☐	☐	☐	☐	☐	0	☐
3 Hour	☐	☐	☐	☐	☐	☐	0	☐
4 Hour	☐	☐	☐	☐	☐	☐	0	☐
6 Hour	☐	☐	☐	☐	☐	☐	0	☐
8 Hour	☐	☐	☐	☐	☐	☐	0	☐
12 Hour	☐	☐	☐	☐	☐	☐	0	☐
24 Hour	☐	☐	☐	☐	☐	☐	0	☐
Monthly	☐	☐	☐	☐	☐	☐	0	☐

Generate Additional Files

☒ Tabulated File of All Concurrent Concentrations (necessary for View Concentrations) (.con)

☐ Threshold Violation File (.thr)
Threshold: ($\mu\text{g}/\text{m}^3$)

☐ File for Contour Plotting (.plt)

☐ File of Ranked Values for Q-Q Plotting (.qqp)

☐ File of Average Values by Season & Hour of Day (.avg)

< Back Generate Cancel Help



Dispersion Enhancements

- ◆ New user interface for buildings

Buildings

Available

In Study

Airpark Building
Hangars

Add New
Add -->
<-- Remove
Delete
Duplicate

Coordinates (feet)

Number of Points: 8

Nudge

Point #	X	Y
1	501.97	-1171....
2	838.20	-1295....
3	647.91	-2091....
4	-95.15	-1874....
5	168.96	-610.47
6	272.30	-645.39
7	359.25	-896.85
8	538.88	-937.27

Name: Airpark Building

Base Elevation: 703 (feet)

Height: 46 (feet)

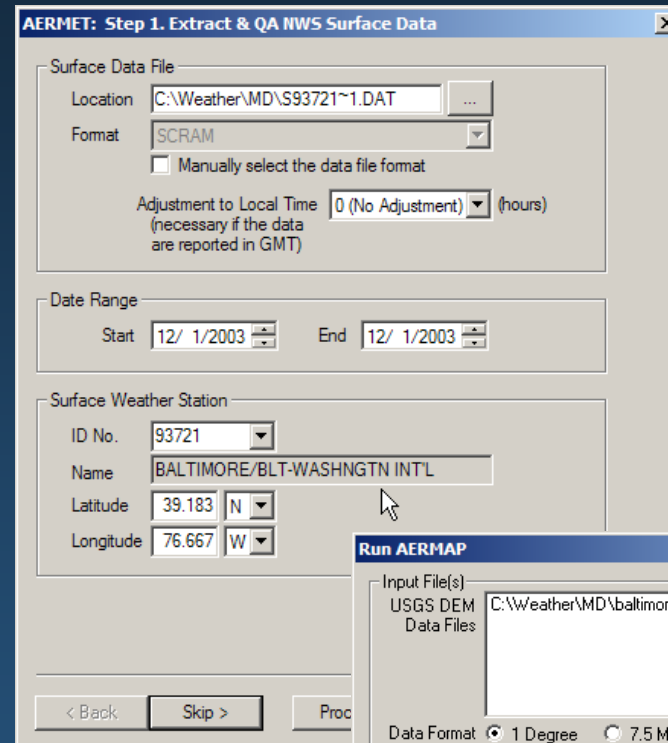
Preview

OK Cancel Apply Help



Dispersion Enhancements

- ◆ Improved AERMET wizard with met station data
- ◆ AERMAP user interface



AERMET: Step 1. Extract & QA NWS Surface Data

Surface Data File

Location: C:\Weather\MD\S93721~1.DAT

Format: SCRAM

☐ Manually select the data file format

Adjustment to Local Time (necessary if the data are reported in GMT): 0 (No Adjustment) (hours)

Date Range

Start: 12/ 1/2003 End: 12/ 1/2003

Surface Weather Station

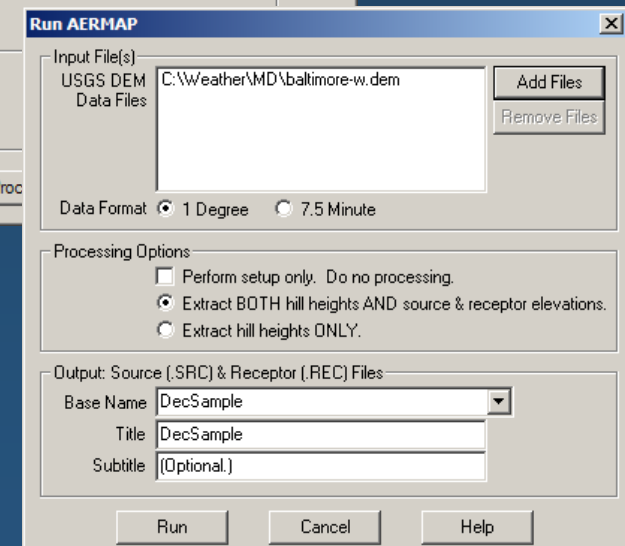
ID No.: 93721

Name: BALTIMORE/BLT-WASHNGTN INT'L

Latitude: 39.183 N

Longitude: 76.667 W

< Back Skip > Proc



Run AERMAP

Input File(s)

USGS DEM Data Files: C:\Weather\MD\baltimore-w.dem

Add Files Remove Files

Data Format: ☒ 1 Degree ☐ 7.5 Minute

Processing Options

☐ Perform setup only. Do no processing.

☒ Extract BOTH hill heights AND source & receptor elevations.

☐ Extract hill heights ONLY.

Output: Source (.SRC) & Receptor (.REC) Files

Base Name: DecSample

Title: DecSample

Subtitle: (Optional.)

Run Cancel Help



Aircraft PM First Order Approximation

- ♦ Provides a conservative estimate of aircraft PM emissions
- ♦ Uses smoke number from ICAO Databank
- ♦ Only applies to commercial jet engines
- ♦ Serves an interim purpose of meeting PM compliance issues now, while the science and accuracy of PM measurement techniques mature

$$\text{Emission Rate}_{\text{Mass of PM}} = 2.4 (\text{Smoke Number})^{1.8} \text{ Fuel Flow}$$



Future Developments

- ♦ AERC Analyses
 - ❖ Multiple scenarios
 - ❖ Multiple years
- ♦ Dynamic Flight Profiles
 - ❖ SAE AIR 1845 methodology
 - ❖ BADA data & methodology
- ♦ Boeing Fuel Flow Method 2
 - ❖ Climate & Meteorology
 - ❖ Modified thrust settings



Future Developments

- ♦ Improved aircraft taxi path definition
 - ❖ Define inbound/outbound paths
 - ❖ Use standard taxiway names
 - ❖ Taxiway assignment obsolete
- ♦ Enhanced roadway/taxiway modeling
 - ❖ Multiple points
 - ❖ Curves
 - ❖ Connected segments
- ♦ Roadway directionality



EDMS Design Review Group

- ♦ 12 experts representing
 - ❖ Government (FAA and EPA)
 - ❖ Academia
 - ❖ Industry
- ♦ Recommend model enhancements
- ♦ Provide technical guidance for model application
- ♦ Review changes to the model
- ♦ Meetings are held as required with frequent interaction between meetings



Aviation Environmental Design Tool (AEDT)

- ♦ Assess interdependencies between aviation-related noise and emissions
- ♦ Incorporating today's tools:
 - ❖ EDMS
 - ❖ SAGE
 - ❖ INM
 - ❖ MAGENTA
- ♦ In development from 2005 through 2010



CONCLUSIONS

- ♦ These enhancements have
 - ❖ Improved accuracy
 - ❖ User flexibility
- ♦ FAA
 - ❖ Researching to better understand aviation emissions
 - ❖ Improving EDMS modeling capability
- ♦ Developments planned in the near future are intended to
 - ❖ Further refine the fidelity
 - ❖ Increase user flexibility
 - ❖ Expand the capabilities of EDMS

