

The Emissions Inventory Database Application Component of the Air Quality Management Decision Support System for Beijing

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For

14th Annual Emission Inventory Conference

Las Vegas, Nevada

April 12-14, 2005

Objective: Improve Air Quality



Two Views of Beijing



Overview

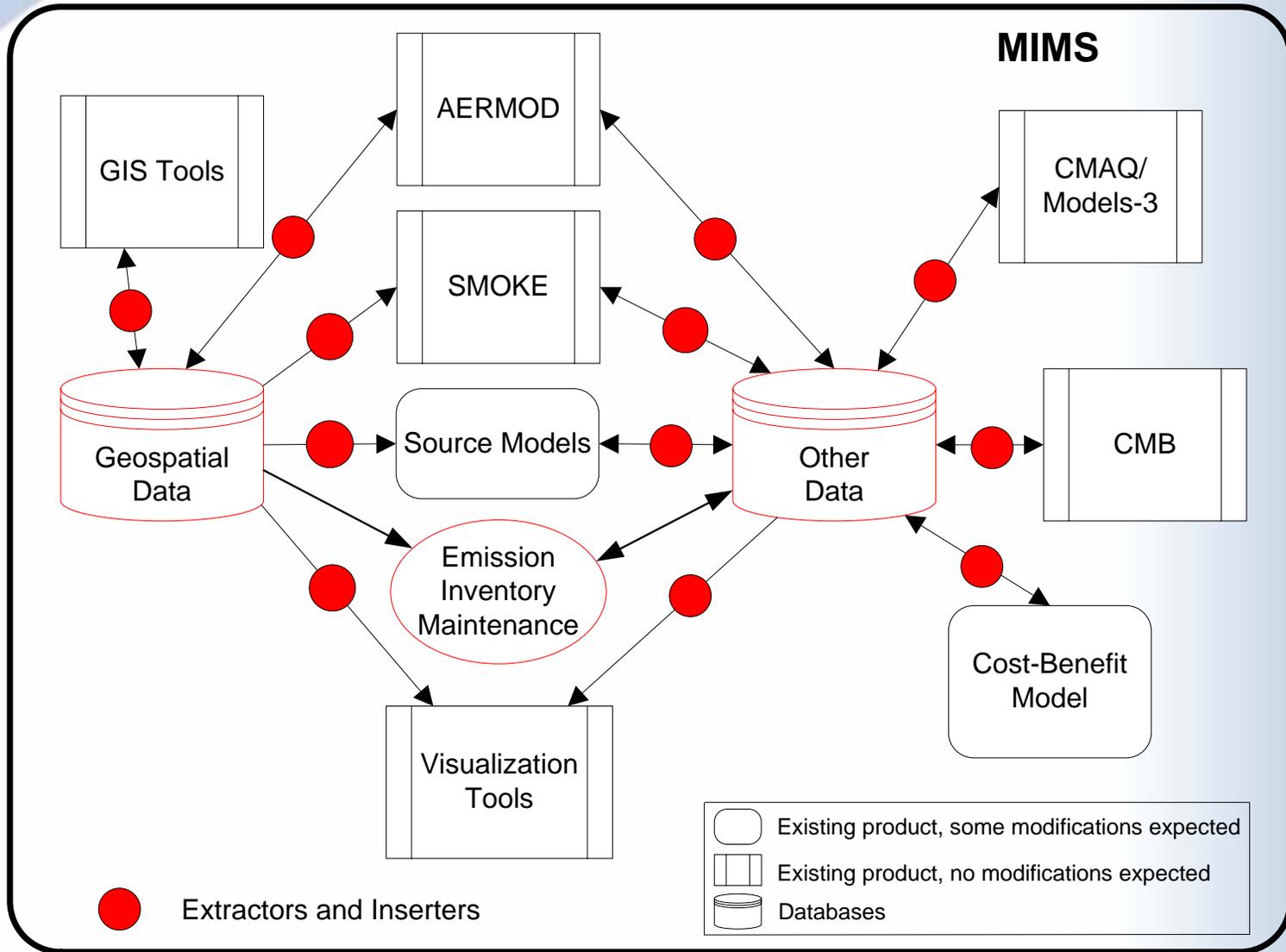
- Project overview
- AQMDSS architecture
- Database design
- Emission inventory application
- User interface
- Status

Project Overview

- Purpose is to create a decision support system for the Beijing Municipal Environmental Protection Bureau (BMEPB)
- Objectives of the AQMDSS:
 - ◆ Help BMEPB to understand the contributors to poor air quality
 - ◆ Provide source apportionment tools
 - ◆ Simulate control decisions
 - ◆ Produce next day air quality forecasts

International Team

- Project management
 - ◆ George Gao, PA Consulting
- AQMDSS design and implementation, arrange training
 - ◆ Robert A. Zerbonia, Jo Ellen Brandmeyer, Eric Solano, Mark Bruhn, Sunil Rao, and Aaron Parks, RTI International
- Translation, loading emissions inventory and other data sets, on-site GIS support, training
 - ◆ Institute of Atmospheric Physics, Beijing Institute of Surveying and Mapping, other research groups

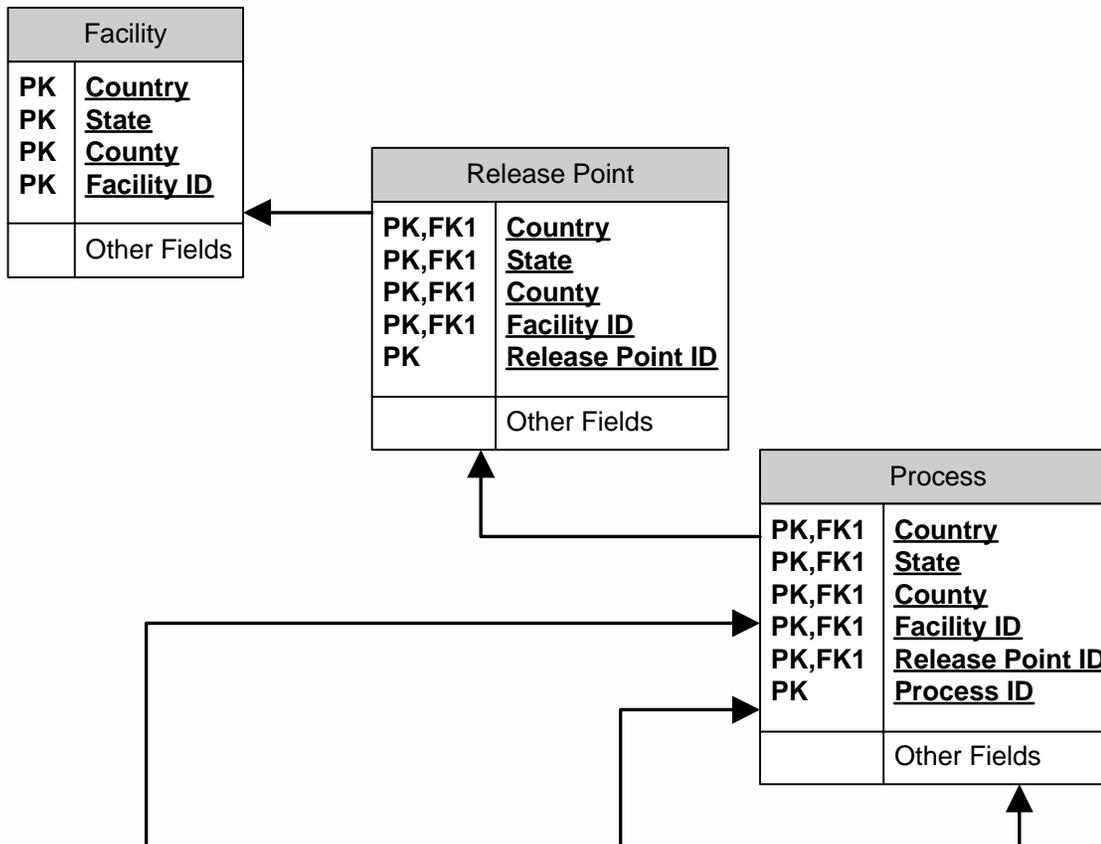


Connectivity

- No changes to models
- Extractors to read data from database
 - ◆ Extract data from database to file structure required by a model
 - ◆ Use parameter values from MIMS scenarios
 - ◆ Convert from metric system to units required by the models
- Inserters to write data to the database
 - ◆ User selects data to add to database for later analysis

Relational Database Design

- Referential integrity included within structure



QA Features Built In

- Codes maintained within database
 - ◆ Pollutants, equipment types, source category codes (SCC)
- Codes validated against lookup tables during data entry
 - ◆ Foreign key constraints
- Range constraints to reduce processing errors
 - ◆ Hours/day, weeks/year

Extensible Design

- Based on National Emission Inventory Input Format version 3.0
 - ◆ Enhanced with country codes for continental inventories
- Additional tables and fields to support processors and models in the AQMDSS
 - ◆ Add new fields to existing tables
 - ◆ Add new, related tables
 - ◆ No effect on operation of existing processors
- Includes spatial data objects for mapping and spatial analyses

Emission Inventory Maintenance

- Designed to minimize data entry errors
 - ◆ Drop-down boxes and browsers for codes
 - ◆ Screens support referential integrity
 - Parent/child frames support parent/child relationships in database
 - ◆ Additional range-checking
- Structure driven by metadata in database
 - ◆ Add more tables and fields with no programming
- Supports multiple types of users

Example Simple Lookup Table

AQMD55 Emissions Database Table Display

Table: Control Devices

Control Device ID	Control Device Description
000	UNCONTROLLED
001	WET SCRUBBER - HIGH EFFICIENCY
002	WET SCRUBBER - MEDIUM EFFICIENCY
003	WET SCRUBBER - LOW EFFICIENCY
004	GRAVITY COLLECTOR - HIGH EFFICIENCY
005	GRAVITY COLLECTOR - MEDIUM EFFICIENCY
006	GRAVITY COLLECTOR - LOW EFFICIENCY
007	CENTRIFUGAL COLLECTOR (CYCLONE) - HIGH EFFICIENCY
008	CENTRIFUGAL COLLECTOR (CYCLONE) - MEDIUM EFFICIENCY
009	CENTRIFUGAL COLLECTOR (CYCLONE) - LOW EFFICIENCY
010	ELECTROSTATIC PRECIPITATOR - HIGH EFFICIENCY
011	ELECTROSTATIC PRECIPITATOR - MEDIUM EFFICIENCY
012	ELECTROSTATIC PRECIPITATOR - LOW EFFICIENCY
013	GAS SCRUBBER (GENERAL, NOT CLASSIFIED)
014	MIST ELIMINATOR - HIGH VELOCITY, I.E. V>250 FT/MIN
015	MIST ELIMINATOR - LOW VELOCITY, I.E. V<250 FT/MIN
016	FABRIC FILTER - HIGH TEMPERATURE, I.E. T>250F
017	FABRIC FILTER - MEDIUM TEMPERATURE, I.E. 180F<T<250F
018	FABRIC FILTER - LOW TEMPERATURE, I.E. T<180F
019	CATALYTIC AFTERBURNER
020	CATALYTIC AFTERBURNER WITH HEAT EXCHANGER
021	DIRECT FLAME AFTERBURNER

Data Rows: 161

OK

Example Multi-column Lookup Table

AQMD55 Emissions Database Table Display

Table: SCC List

SCC	Sector Type	SCC Level 1	SCC Level 1	SCC Level 2	SCC Level 2	SCC Level 3	SCC Level 3	SCC L
2201001330	ON-ROAD	22	Mobile Sources	2201	Highway Vehi...	2201001	Light Duty Ga...	220100
2230060210	ON-ROAD	22	Mobile Sources	2230	Highway Vehi...	2230060	Light Duty Die...	223006
2230073210	ON-ROAD	22	Mobile Sources	2230	Highway Vehi...	2230073	Heavy Duty Di...	223007
2260002045	NONROAD	22	Mobile Sources	2260	Off-highway V...	2260002	Construction ...	226000
2268001020	NONROAD	22	Mobile Sources	2268	CNG	2268001	Recreational ...	226800
2390004000	AREA	23	Industrial Pro...	2390	In-process Fu...	2390004	Distillate Oil	239000
2461000000	AREA	24	Solvent Utiliza...	2461	Miscellaneous...	2461000	All Processes	246100
2505030030	AREA	25	Storage and ...	2505	Petroleum an...	2505030	Truck	250503
2515040310	AREA	25	Storage and ...	2515	Organic Che...	2515040	Pipeline	251504
2801600000	AREA	28	Miscellaneous...	2801	Agriculture Pr...	2801600	Country Grain...	280160
30800105	POINT	30	Industrial Pro...	3080	Rubber and ...	308001	Tire Manufact...	308001
30183001	POINT	30	Industrial Pro...	3018	Chemical Ma...	301830	General Proc...	301830
31303502	POINT	31	Industrial Pro...	3130	Electrical Equ...	313035	Manufacturin...	313035
2101001000	AREA	21	Stationary So...	2101	Electric Utility	2101001	Anthracite Coal	210100
2101002000	AREA	21	Stationary So...	2101	Electric Utility	2101002	Bituminous/S...	210100
2101003000	AREA	21	Stationary So...	2101	Electric Utility	2101003	Lignite Coal	210100
2101004000	AREA	21	Stationary So...	2101	Electric Utility	2101004	Distillate Oil	210100
2101004001	AREA	21	Stationary So...	2101	Electric Utility	2101004	Distillate Oil	210100
2101004002	AREA	21	Stationary So...	2101	Electric Utility	2101004	Distillate Oil	210100
2101005000	AREA	21	Stationary So...	2101	Electric Utility	2101005	Residual Oil	210100
2101006000	AREA	21	Stationary So...	2101	Electric Utility	2101006	Natural Gas	210100
2101006001	AREA	21	Stationary So...	2101	Electric Utility	2101006	Natural Gas	210100

Data Rows: 9,738

OK

Example Data Entry Menu

Data Maintenance [Window Title Bar]

Select Table to Modify From a Table Group [Section Header]

Table Groups	Table Description		
Area Source Data	Area Source Processes	Add	Update
On-Road Mobile Source Data	Reference Counties for On-Road Mobile Sources	Add	Update
Biogenic Source Data	BEIS3 Emission Factors	Add	Update
Point Source Data	Sites for Point Sources	Add	Update
Ambient Data	Ambient Stations	Add	Update
AERMOD Data	AERMOD Site Data	Add	Update
Supporting Tables	Ambient Data Parameters	Add	Update
Master Tables	Material Input/Output	Add	Update

[Done]

Example Data Entry Screen

Adding a Record (Part II: Additional Fields)

Enter or Select Additional Values to Create a New Record
Table: Sites for Point Sources

Variable	Values Range	Permitted Values	Value
Facility ID	No Range	na	
Facility Category ID	No Range	na	01
CEMS Facility ID	No Range	na	
SIC ID	No Range	na	0161
Name of Facility	No Range	na	0116 0119
Site Description	No Range	na	0131 0132 0133 0134
Address	No Range	na	0139 0161
City	No Range	na	
County	No Range	na	
Province	No Range	na	
Postal Code	No Range	na	
Latitude	No Range	na	
Longitude	No Range	na	
Elevation of Facility	No Range	na	

OK Done

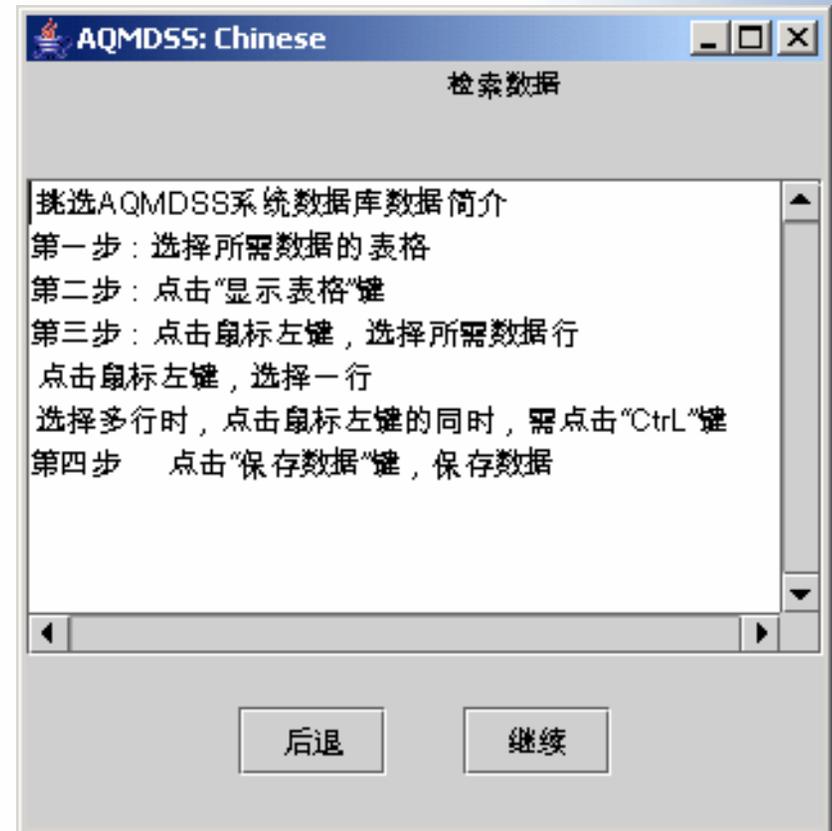
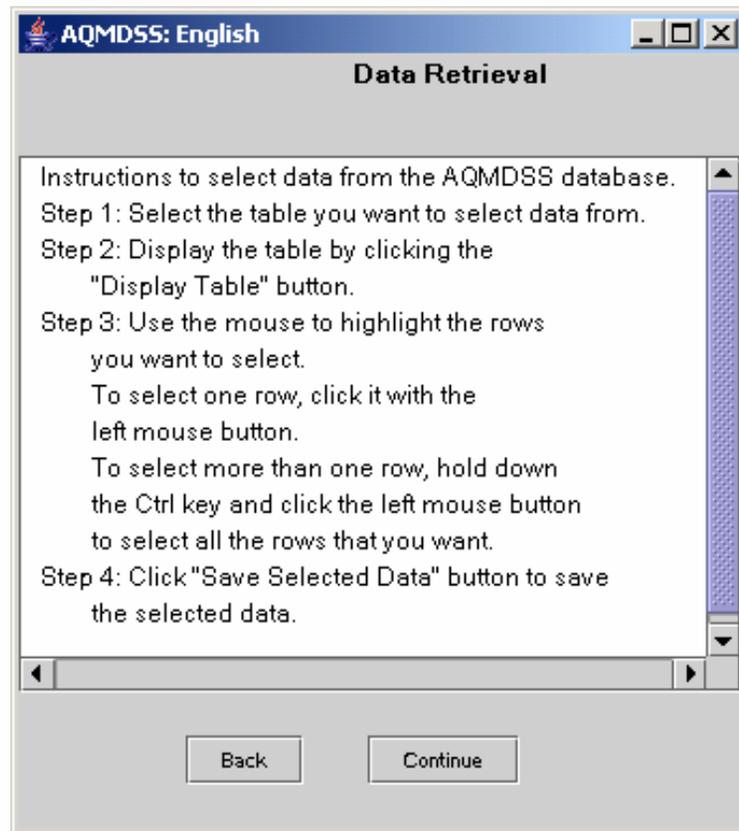
Internationalized User Interface

- Data entry screens and messages to user
 - ◆ Program looks up strings to display
- All strings are in text files
 - ◆ Simplifies translation and maintenance
- Providing AQMDSS using both Chinese and English strings
 - ◆ Easily translatable to other languages (e.g., Spanish)
 - ◆ Default is English for any string not found in target language

Find a String to Display

- Hierarchy using **locale** of current user
 - ◆ Language, Country, System
 - ◆ Language, Country
 - ◆ Language
 - ◆ Default
- Hierarchical search for each string
 - ◆ Reduce changes between countries for same language

Internationalization Example



Status

- Design Report – complete and accepted
- Implementation – in progress
- Testing with test data – this summer
- Delivery to consultants in Beijing to load real data
- Final testing in Beijing
- Target delivery date to BMEPB – December 2005
- Final report – April 2006

Questions?