RAIMI - A Practical Approach for Implementing Cumulative Type Assessments on a Localized Scale

U.S. EPA Region 6

Multimedia Planning and Permitting Division

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4.0 REGIONAL AIR IMPACT MODELING INITIATIVE (RAIMI)

EPA Region 6 initiated design of the RAIMI Program in 1999 to evaluate:

Region-wide estimation of potential health risks, on a community level of resolution, as a result of exposure to multiple contaminants/sources/exposure pathways.

As a test of the RAIMI methods and approach, a Pilot Study was designed and implemented in a small area in southeast Texas.

4.0 REGIONAL AIR IMPACT MODELING INITIATIVE (RAIMI)

Establishment of the RAIMI Program is being driven in part by national initiatives that identify the need for a more refined assessment, including:

- CUMULATIVE EXPOSURE PROJECT
- RESIDUAL RISK REPORT TO CONGRESS
- INTEGRATED URBAN AIR TOXICS STRATEGY
- NATIONAL AIR TOXICS ASSESSMENT

4.0 RAIMI DESIGN STRATEGY

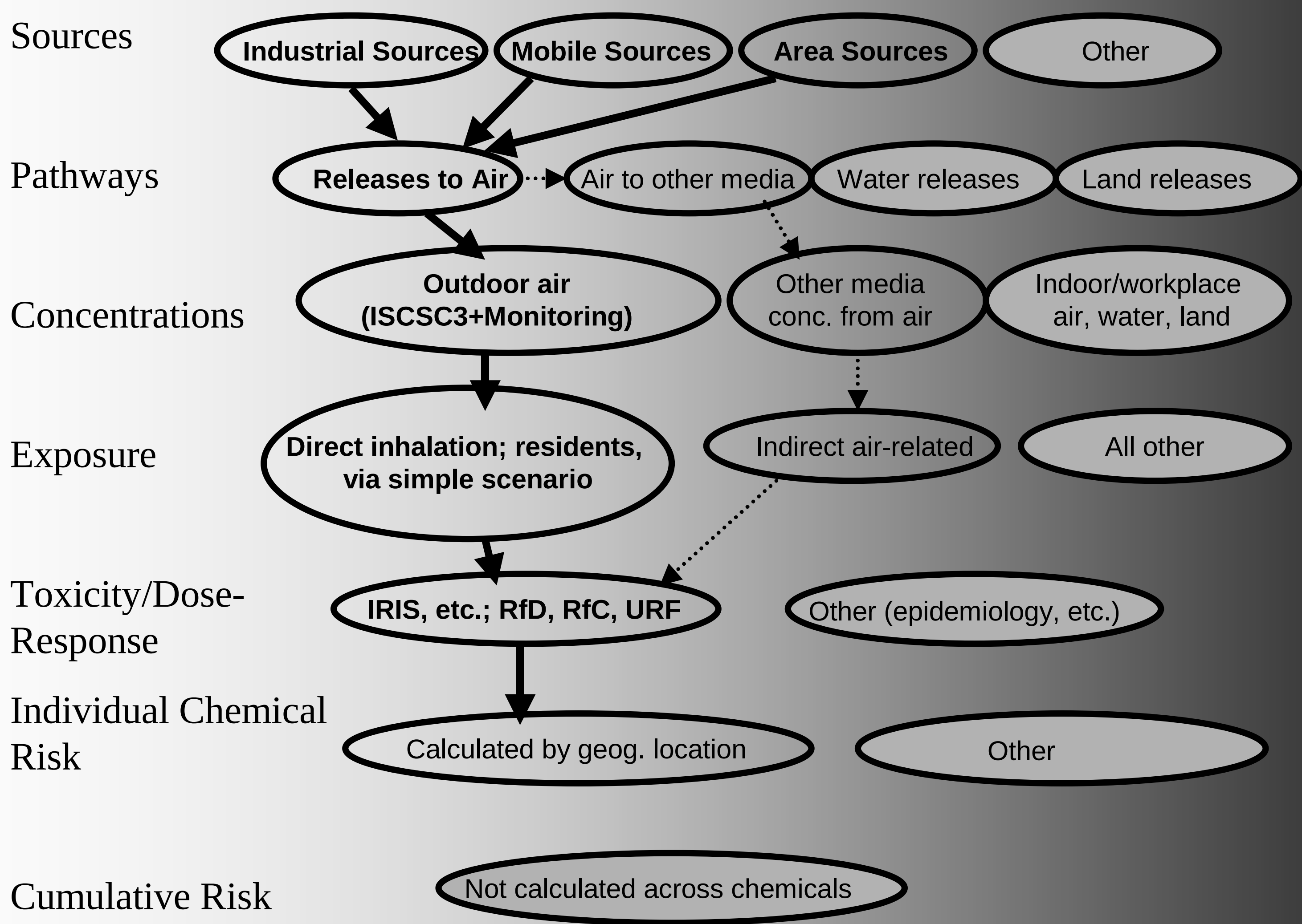
- Provide A **Consistent Means By Which Permitting Authorities Could Account For And Assess Potential Health Effects** To Multiple Contaminants From Multiple Sources, Which Are Often Subject To Multiple Permitting Schemes, But Cumulatively Impacting The Same Receptor Neighborhoods

- Useful As A Permitting Tool To Support EPA, State, And Local Permitting Authorities-independently Or Combined-**Evaluate And Demonstrate Protectiveness Of Cross Program (e.g., RCRA, CAA, Exempt) Permitting Decisions** And Support Holistic, Tailored Permit Strategies

- **Calculate And Track Risks From Literally Hundreds Of Sources And Contaminants** Based On Actual Emissions Data. As New Or Refined Data Become Available, It Can Be Directly Incorporated Into The Assessment To Obtain Revised Risk Estimates On A Real Time Basis

- Provide Necessary Information To **Prioritize And Identify Solutions**, For Sources Resulting In Unacceptable Risks, At A **Community Level Of Resolution**, And Generated In A Fully Transparent Fashion Such That **Risk Levels Are Traceable To Each Contaminant, Each Pathway, And Each Source**

Conceptual Model



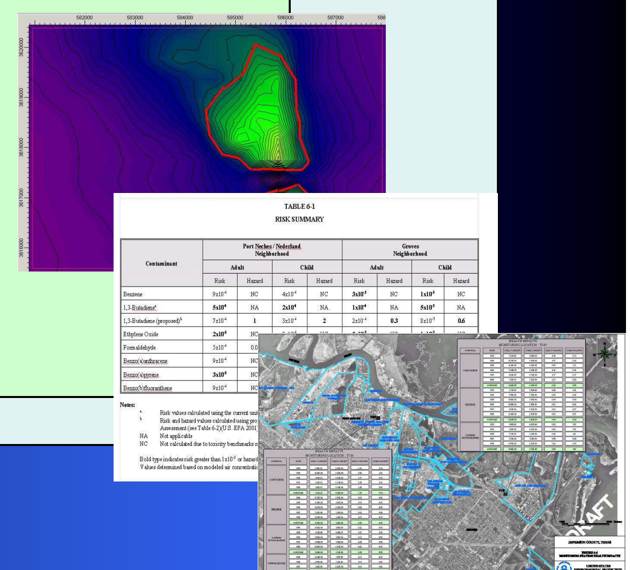
Risk - Management and Analysis Platform (Risk–MAP)

Project Database

Emissions Characterization Component
- Integration of Primary Emission Databases (DataMiner)
- Data Quality Review and Data Extraction (ACCESS)

Air Modeling Component
- Preprocessing of Air Modeling Inputs (AMP)
- Execute Air Dispersion Model (ISCST3)

Risk Modeling Component
- Site Assessment and Data Input Processing (Risk-MAP)
- Generate Risk Results and Perform Data Analysis (Risk-MAP)
- Map and Report Generation (Risk-MAP)
- Solutions Implementation and Performance Review



7.0 GIS PROJECT PLATFORM

7.2 GIS Platform Construct

- ***ArcGIS***™ **:** core platform to that provides operating environment for required databases, data management operations; and risk modeling module (Risk–MAP)
- ***ETD*****:** string of inter-linked database tables; database structure and functionality designed to support cumulative type assessments requiring large capacity and high resolution of results for solution management
- ***Risk - MAP*****:** risk modeling module; calculates exposure pathway specific values in a spatially layered data environment; supports capacities typically required of cumulative type studies; and custom visual displaying of interim and final results in traditional (tabular, etc.) and mapped (isopleths, spatial attributes, attribution tracking, etc.) formats to support solution consideration, implementation, and tracking

8.1 EMISSIONS CHARACTERIZATION

8.2 Emissions Data Needs

- **Source-Specific Parameter Values:** Required to support completion of air modeling component on a source-specific basis. Must comply with DQOs for air modeling inputs.

- **Speciated Emission Rates:** Required for accurate risk modeling, solution implementation, and attribution profiling. Generic contaminant groupings (total VOCs, gasoline, crude oil, etc.) may compromise project objectives.

- **Source-Specific Attributes:** Required to support trending analysis and possibly solution implementation. Examples may include permit status, source type, industry type, enforcement history, facility ID, SCC, etc.

8.0 EMISSIONS CHARACTERIZATION

8.5 Database Issues

Inventory Completeness Example

- **Different reporting requirements can result in substantially different content**
- **For example, the 1997 PSDB and TRI indicate the following:**

Contaminant	TRI Emissions	PSDB Emissions
Benzene	71,501 pounds	172,422 pounds
1,3-Butadiene	241,099 pounds	495,624 pounds
Ethylene Oxide	52,000 pounds	89,002 pounds

- **Do not conclude that PSDB is more complete than TRI!**

8.0 EMISSIONS CHARACTERIZATION

8.5 Database Issues

Inventory Completeness (cont.)

Facility	TRI Emissions 1,3-Butadiene	PSDB Emissions 1,3-Butadiene
Ameripol Synpol	**18,500** pounds	**11,660** pounds
Dupont Dow Elastomers	8,599 pounds	7,508 pounds
Huntsman Corporation	214,000 pounds	476,456 pounds

- **PSDB butadiene emissions at Ameripol Synpol are less than the TRI emissions**
- **Applying the TRI emission value to the source(s) at Ameripol Synpol is one option for evaluating the risk-based significance of this data gap**

9.0 AIR MODELING COMPONENT

9.2 Overview of Air Modeling Approach

- **Applies "single-pass" air modeling for each source**
  - **Up-front** production of **all necessary air modeling** data to support **current** and anticipated **future** risk modeling needs
  - Use of **unit emission rates** enables one set of model runs for modeling each emission source to accommodate **any** combination of **emissions scenarios** (e.g., reported actual emissions, permitted allowable emissions, revised quantities of emissions due to operational changes, or inclusion of new contaminants in the emissions profile)
  - **Phase-specific** modeling runs for emissions **partitioning (vapor, particle, particle-bound, mercury)**

9.0 AIR MODELING COMPONENT

9.2 Overview of Air Modeling Approach

- **Applies "universal grid"**
  - **All data converted** and **stored** in **standardized geographic coordinate system** (NAD 83 Latitude/Longitude curvilinear) for quantitative data processing and qualitative display
  - **Real-time conversion** to any standard coordinate system for component-specific data processing (e.g., air model component requires UTM rectilinear coordinates)
  - **Point-to-point** spatial and scale alignment of layered datasets from **various database caretakers** in various coordinate systems unified into single universal system

9.0 AIR MODELING COMPONENT

9.2 Overview of Air Modeling Approach

Modeling of Individual Sources:

- **Separate air modeling runs** conducted specific to each individual source modeled
- **Source locations** reviewed for accuracy through a stepwise geo-correction process (small variance - dramatic effect on modeled results)
- **Source-specific inputs** obtained from emissions inventory data; assignment of surrogate values missing physical characteristics data an option (except for particle density and size distribution)
- A facility may define a **fugitive source** either as a stack or an area source, but in such cases, the physical characteristics for the source as reported in the emissions inventory are used in the air modeling without redefinition

9.0 AIR MODELING COMPONENT

9.4 Air Modeling Tools:

- ***AMP*** **:** automates labor-intensive, site-specific data preparation and pre-processing to facilitate completion of air modeling on multiple sources in a reasonable time period **by:**
  - **Importing GIS** data for human **geo-location** of source inventory (source/facility plot files, land use, topo map, aerial photos)
  - **Computing** source-specific **site parameters** (surface roughness for 12 30-degree sectors and urban/rural land use to 3 km for each source)
  - **Auto-generates** and **processes met files for 5 years** of hourly weather data for each source
  - **Auto-generates** ISCST3 **input files** for all four phases (v,p,b,h), including grid node array with terrain elevations, wet/dry deposition
- ***AIR2GIS*** **: executes ISCST3 in batch mode, and converts plot files to format for import into GIS Platform for risk modeling**

10.0 RISK MODELING COMPONENT

10.2 Overview of Risk Modeling Approach

- **Implements true “receptor-based” approach**
  - **Focuses on defining impacts to target receptor locations or neighborhood area.**
  - **Each target neighborhood can have customized exposure inputs that may influence results, management decisions, and communication.**
  - **Structure allows data to be generated and managed at the neighborhood or receptor level; while maintaining coverage over large geographic areas (e.g., county, state, region).**
  - **Foundation of the dynamic project platform.**

10.0 RISK MODELING COMPONENT

10.2 Overview of Risk Modeling Approach

- **Applies "simplified" exposure scenarios**
  - **For example, default exposure assumptions and inputs for inhalation pathway based on an individual breathing outdoor air concentrations 24 hours per day, 350 days per year**
  - **Pathway driven (e.g., inhalation)**
  - **Does not include indoor air**
  - **Does not include micro-exposure activity patterns**

10.0 RISK MODELING COMPONENT

➢ How to Use Results

1. Conduct Risk-Based Prioritizations

RAIMI can be used to conduct risk-based prioritizations specific to contaminants, facilities, emission sources, and data gaps.

For example, Pilot Study results indicate for a profiled neighborhood:

- **1,3-Butadiene is a risk concern;**
- **Identified emission sources at the Huntsman and Ameripol Synpol facilities are the most significant known contributors of 1,3-butadiene to this neighborhood; and**
- **Incomplete emissions characterization appears to be the most significant data gap effecting results.**

10.0 RISK MODELING COMPONENT

➢ How to Use Results

2. Complement National-Scale Assessments

The more refined localized approach of the RAIMI can be used to complement national-scale assessments that generally report risk concerns on a broad scale (i.e., county-level resolution).

- **By providing results at an increased level of resolution such that risk based concerns can be identified specific to neighborhoods and definable emission sources**
- **By providing an increased level of source specificity and detail required not only for prioritization, but also for accurate development and tracking of solutions to manage risk concerns**
- **By using actual values versus simplifying assumptions for sensitive input parameters (i.e., source locations) to increase accuracy**

10.0 RISK MODELING COMPONENT

➢ How to Use Results

3. Identify Risk Trends (Trending Analysis)

Results can be used to correlate source characteristics with risk results to analyze trends of interest by linking results to various source attributes such as regulatory status, source type, SCC, stack height, or any other source attribute being tracked.

- **For example, Pilot Study results indicate that wastewater treatment units exhibit a significant trend with regard to 1,3-butadiene emissions.**
- **Regulators and facilities can use this information now to begin evaluating alternative methods of wastewater treatment to control emissions**

10.0 RISK MODELING COMPONENT

➢ How to Use Results

4. Determine Significance of Data Gaps

The potential significance of data gaps with regards to influence on results can be determined within the RAIMI approach through numerical substitutions of best and worst case scenarios for each data gap, and observing effects on results. For example:

- **The Huntsman Corporation facility, reported 238 tpy of 1,3-butadiene emissions, also reports 1,779 tpy of unspeciated nonmethane VOCs.**
- **The potential significance of the unspeciated emissions as a source of 1,3-butadiene can be determined by evaluating a portion of the unspeciated emissions as 1,3-butadiene.**

10.0 RISK MODELING COMPONENT

➢ How to Use Results

5. Track Emissions Reduction Efforts

- ➢ Emissions reduction efforts to be correlated to effective reductions in modeled risk, and tracked from year to year.
- ➢ National-scale assessments are often criticized because the emissions inventories are outdated.
- ➢ RAIMI results were based on a 1997 emissions inventory that has assuredly changed.
- ➢ New inventories, can readily be integrated into the RAIMI project to assess changes in risk impacts for current reported emissions compared to previous years.

10.0 RISK MODELING COMPONENT

➢ How to Use Results

6. Support Monitoring Programs

- **Optimize monitoring design** with respect to emissions quantities and contaminant toxicities to ensure that the system focuses on the contaminants and sources that pose the greatest local concern.
- **Isolate a potential monitoring location** that focuses on the emissions sources subject to a particular control program, minimizing potential interference from excluded sources.
- **Observe pollution trends** throughout an assessment area, particularly as new emissions sources come on- or off-line over time.