Developing Emission Inventory Bounding Estimates For Use in Community-Based Risk Assessments

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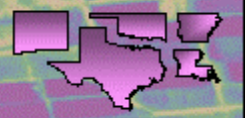


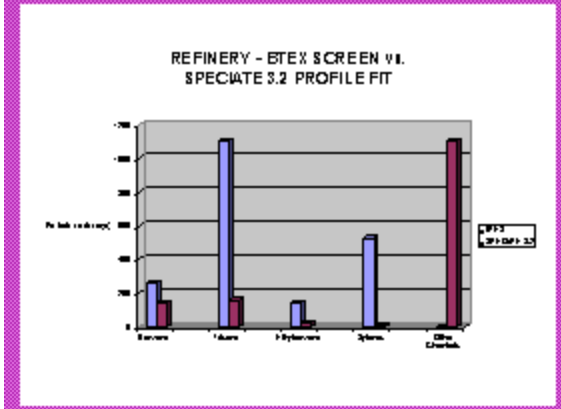
ABSTRACT

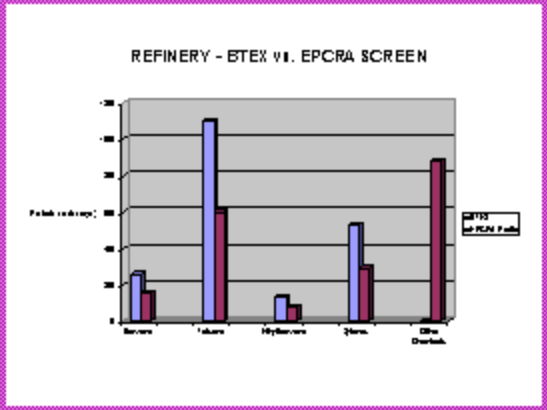
There are mounting concerns that health risks from exposures to environmental agents in the United States are greater (relative to the general population) for residents living in heavily industrialized counties. Such concerns can be promptly confirmed or denied via community-based risk assessments. The validity of such screening assessments relies heavily on the quality of available emission inventories. Most, if not all, available emissions databases are not designed to support risk analysis. Additionally, facility-reported air emission data are frequently reported grouped into general categories (e.g., non-methane volatile organic chemicals (NMVOC), gasoline, fuel oil #2, etc). Emissions then require chemical speciation estimates prior to implementing risk assessments of hazardous air pollutants (HAPs) to assess potential impacts to residents living in close proximity to industrialized areas.

Three estimation methods were employed for independently speciating NMVOC grouped emissions (Oklahoma Point Source Emissions Database) as part of a recently completed air toxics study assessing community-based risks in a heavily industrialized county. Chemical profiles published for a wide variety of U.S. industrial sources (Speciate 3.2) were fit to individual facility emission points and speciation results were compared with two different quick-screening approaches (utilizing the facility's EPCRA (Emergency Planning & Community Right-To-Know Act) Section 313 chemical data). These three speciation approaches were used to bound HAP emissions and subsequently evaluate potential community-risks for over 2,000 tons of unspeciated NMVOC emissions originating from a large petroleum refinery operating in the study area. The relative usability and utility of each of the three chemical speciation approaches was evaluated relative to eight data quality objectives (DQOs) for the regional air toxics project.

OBJECTIVES

The objectives of this study were to speciate NMVOC grouped emissions by several different methods, compare risk modeling results and use the Project's DQOs (i.e., *defensibility* - relies on approved methods; numerically *correct* & *consistent*; *time efficient*; *cost efficient*; *flexible* – able to *analyze variations*/what ifs; provides *interim utility*; directly applicable to *end user's needs*; directly supports *solution implementation*) to assess the relative usability and utility of each speciation method. Air emissions reported in categories (i.e., NMVOC – non-methane volatile organic compounds) frequently represent a large percentage of an industrial facility's total emissions inventory. Although NMVOC emissions encompass hazardous air pollutants (HAPs), unspeciated emissions (e.g. 50–98% routinely encountered) are not directly useable for assessing health impacts to communities adjacent to heavily industrialized areas.





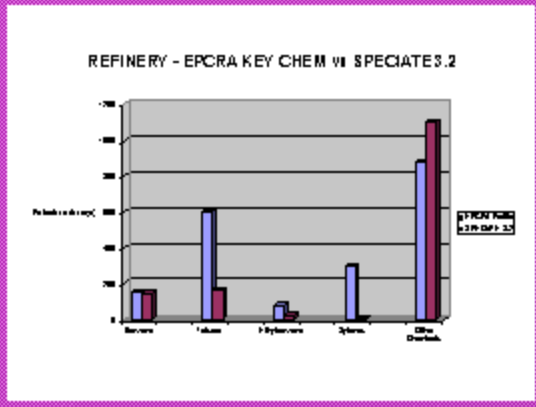


TABLE 1.0
SPECIATION RESULTS
(Benzene at Refinery Location Node 13707)

NMVOC Speciation Methods	Concentration (ug/m^3)	Cancer Risk	Hazard Quotient (HQ) (Non-Cancer Risk)
SPECIATE Version 3.2	397.5	3.1×10^{-3}	44.2
EPCRA – BTEX	269.2	2.1×10^{-3}	29.9
EPCRA – Key Chemicals	155.0	1.2×10^{-3}	17.2

High = strong fit to criteria (3)

Medium = moderate fit to criteria (2)

Low = weak fit to criteria (1)

TABLE 2.0
NMVOC SPECIATION DQOs

NMVOC Speciation Methods	Defens Appvd Mthds	Num Corr & Con	Time Efficnt	Cost Efficnt	Flxble Var & Cont	Intrm Utility	End User's Needs	Suprt Soln Implm
SPEC 3.2 (13 pts)	*High (3)*	*Low (1)*	*Low (1)*	*Med (2)*	*Low (1)*	*Med (2)*	*Med (2)*	*Low (1)*
EPCRA BTEX (19 pts)	*Low (1)*	*Med (2)*	*High (3)*	*High (3)*	*Med (2)*	*High (3)*	*High (3)*	*Med (2)*
EPCRA – Key Chems (22 pts)	*Med (2)*	*Med (2)*	*High (3)*	*High (3)*	*High (3)*	*High (3)*	*High (3)*	*High (3)*

High = strong fit to criteria (3)

Medium = moderate fit to criteria (2)

Low = weak fit to criteria (1)

RESULTS

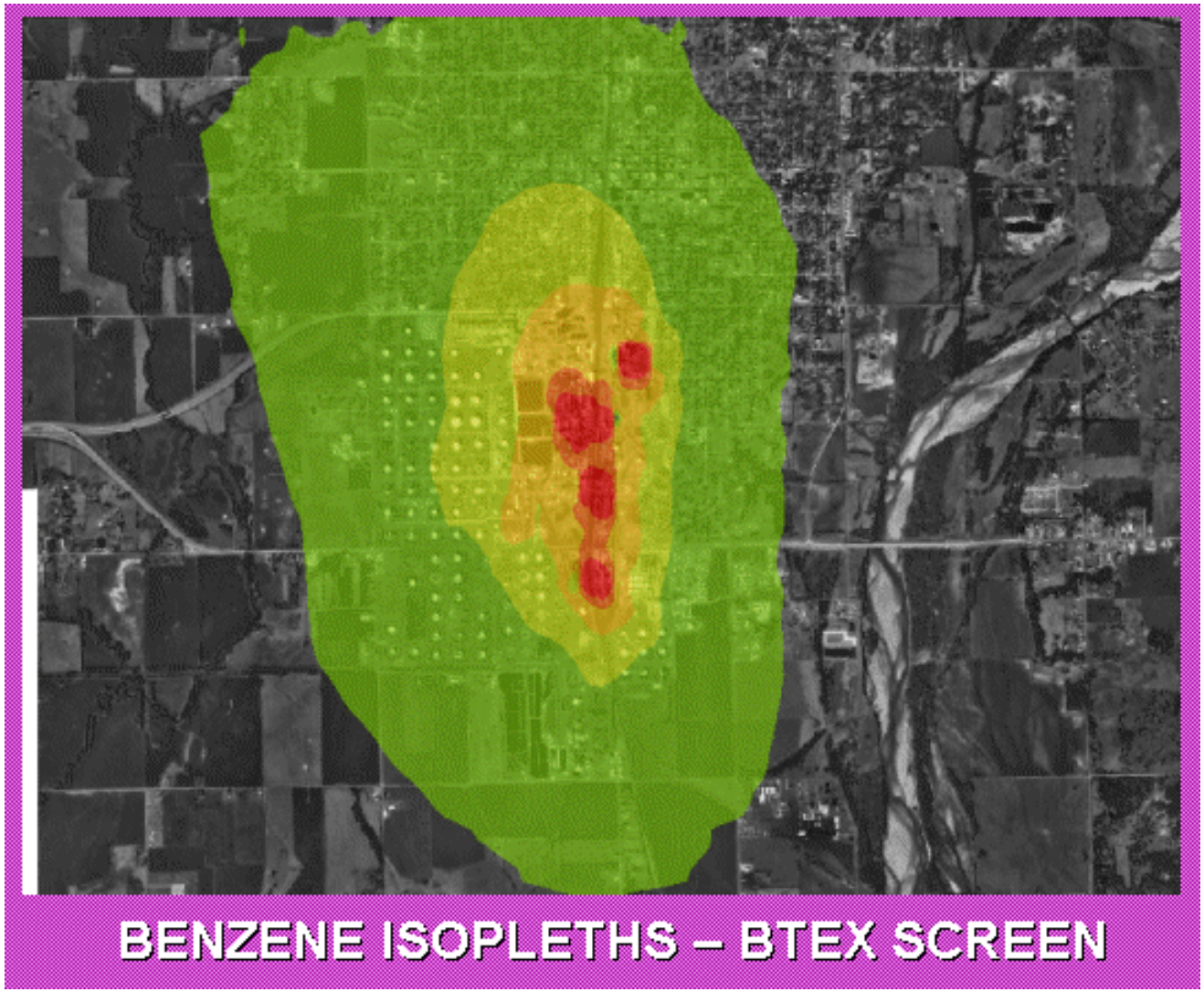
All three speciation methods yielded comparable concentrations of the primary risk driving chemicals for the petroleum refinery. The BTEX method (all NMVOC emissions apportioned at the facility's EPCRA-reported ratio of BTEX compounds) predictably yielded the highest concentrations. Both the EPCRA Key Chemical and Speciate 3.2 Profiling Methods yielded lower benzene concentrations (versus BTEX) (See Table 1.0) with Speciate 3.2 posting higher levels likely due to its pre-fugitive control study period. Evaluating all three speciation methods to the project's eight data quality objectives (See Table 2.0) ranked both EPCRA NMVOC speciation approaches ahead of the Speciate 3.2 Process. The Speciate 3.2 Process is restricted by its limited industrial capabilities (i.e., chemical manufacturing & refineries) and its process and speciation fits and their associated uncertainties. The EPCRA Key Chemical - NMVOC Speciation Method has the benefit of facility-reported chemical data plus the broad utility to provide speciation estimates for any type of U.S. industry.

REFERENCES

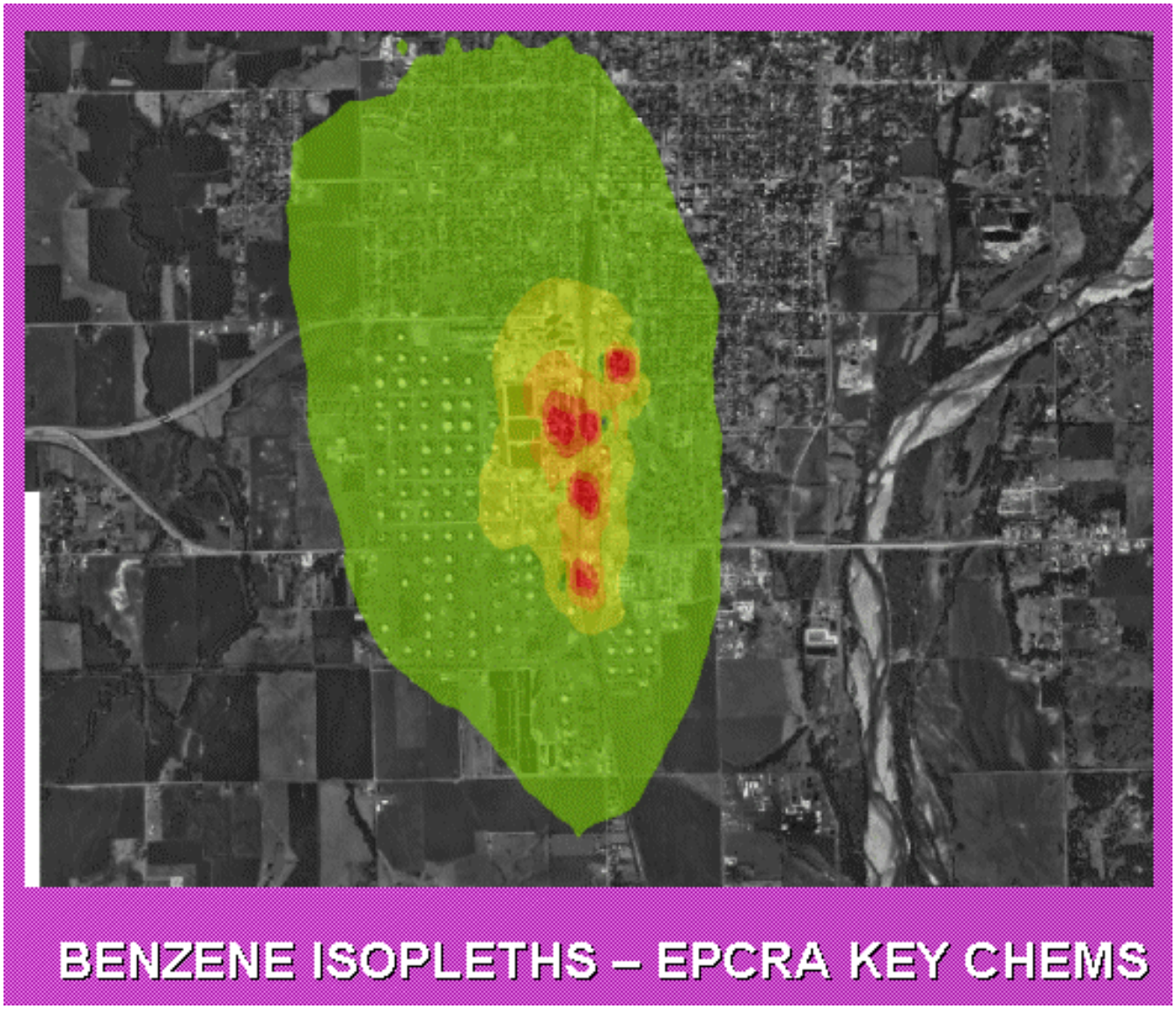
U.S. EPA Region 6 – Oklahoma Department of Environmental Quality (ODEQ) Joint Study – Ponca City Air Toxics Project (February, 2004) - Project details and final summary report are available on the Internet at:
http://www.deq.state.ok.us/AQDNew/resources/reports/Ponca%20City%20assesment.doc

SPECIATE 3.2 – Speciate is EPA's repository of Total Organic Compound (TOC) and Particulate Matter (PM) speciated profiles for a wide variety of sources. Speciate (Version) 3.2 is a 32-bit, 3 MB EXE Windows program that was posted to the CHIEF (Clearinghouse for Inventories and Emission Factors) Web Site in November, 2002.
(http://epa.gov/ttn/chief/software/speciate)

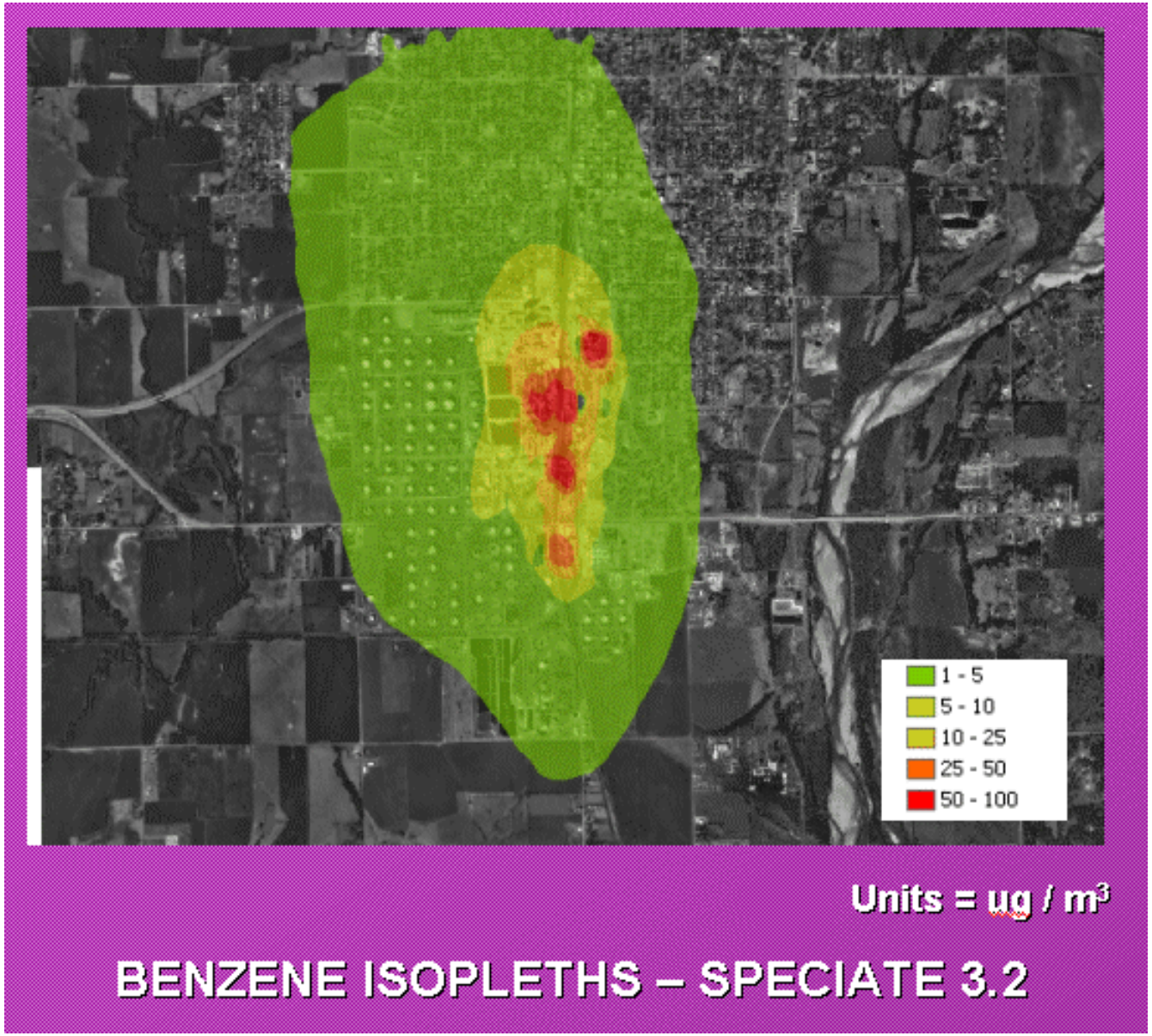
RAIMI – Regional Air Impact Modeling Initiative. U.S. EPA Region 6 MultiMedia Planning & Permitting Division, Facility Assessment Section, Dallas, TX.
(http://www.epa.gov/earth/r6/6pd/rcra_c/raimi/raimi.htm)



BENZENE ISOPLETHS – BTEX SCREEN



BENZENE ISOPLETHS – EPCRA KEY CHEMS


1 - 5
5 - 10
10 - 25
25 - 50
50 - 100
Units = ug / m3
BENZENE ISOPLETHS – SPECIATE 3.2