

Bridging the Knowledge and Data Gaps

Facilitating Access to Atmospheric Emission Data



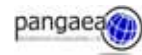
Overview

- 1986 TOXIC SUBSTANCES CONTROL AGREEMENT
- 1990 CLEAN AIR ACT AMENDMENTS
- Great Waters Program - 112(M)
 - identify and assess the extent of atmospheric deposition to the Great Lakes and coastal waters of the U.S.
- Since 1989, the Great Lakes states and the Province of Ontario have been working with the Great Lakes Commission to develop a computerized regional air toxic emissions database.
 - Establish mechanism for cooperation
 - Identify target compounds
 - Establish protocol and common tools for emissions estimation

Presented by: Kevin Yam and Shon Doesck
RDX 2004 – October 26th-28th, 2004, Detroit, Michigan



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Overview

- Multi-year inventory containing annual toxic releases from industrial facilities
 - Aggregated at multiple levels, but available at device / process level for many facilities
- Presently inventory data for multiple years:
 - 1993 (demo), 1996, 1997, 1998, 1999, 2001
 - Presently 213 pollutants being monitored
- Regional Air Pollutant Inventory Development System Inventory tool
 - access to data and inventory preparation

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Overview

Pollutant Emissions for a Single Source Category

Pollutant Code	Emissions (lb)				Total	Percent (%)			
	Point	Area	Onroad	Nonroad		Point	Area	Onroad	Nonroad
COPPER	1,070,417.0	4,134.3	193,173.4	1,247.5	1,268,972.2	84.35	0.33	15.22	0.10
LEAD	1,307,633.0	12,900.0	51,576.1	216,176.1	1,588,285.2	82.33	0.81	3.25	13.61
LEAD,ALK		0.7			0.7		100.00		
NICKEL	653,571.6	16,731.5	5,464.8	93,339.1	769,107.1	84.98	2.18	0.71	12.14
MERCURY	51,850.7	2,062.3	9,088.4	4,266.1	67,267.6	77.08	3.07	13.51	6.34
MANGANESE	1,620,964.3	9,541.0	4,672.3	8,417.8	1,643,595.4	98.62	0.58	0.28	0.51
SELENIUM	433,510.1	1,570.1	533.5	245.4	435,859.1	99.46	0.36	0.12	0.06
Metal Total	6,086,726	83,322	278,080	336,412	6,784,541	89.71	1.23	4.10	4.96
Non-Metal Compounds (Excluding PAHs)									
ACETALDEHYDE	1,682,402.9	1,464,083.1	21,474,876.1	13,866,782.6	38,488,144.6	4.37	3.80	55.80	36.03
ACETAMIDE	5.0	7.5			12.5	40.08	59.92		
ACETONITRILE	263,276.1	2,804.0			266,080.0	98.95	1.05		
ACETOPHENONE	42,517.5	1,709.1			44,226.6	96.14	3.86		
ACETYLAMIN,2	325.3				325.3	100.00			
ACROLEIN	216,145.5	1,367,287.2	2,533,291.5	1,685,284.2	5,802,008.4	3.73	23.57	43.66	29.05
ACRYLAMIDE	3,818.0				3,818.0	100.00			
Breakdown of Emissions by Source Category									
Other Sources**	155,548,802.00				155,548,802.00				
Recreational vehicles	47,820,983.04				47,820,983.04				
SOV	93,876,860.88				93,876,860.88				
DDT's	42,106,473.21				42,106,473.21				
Boat and garden equipment	27,232,236.00				27,232,236.00				
Total Estimated Emissions: 497,538,509 lbs.									

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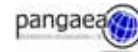
Issues and challenges

- Regionally exchanging data, however:
 - Lack of access
 - Annual printed / PDF reports
 - RAPIDS desktop users (authorized users only)
 - Inherently a geospatial problem but without spatially enabled data
- Opening of a dialog among numerous political jurisdictions on air toxics problems

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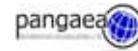
CAROL - Needs Assessment

- Initiate the Centralized Air emission Repository On-Line (CAROL) with EPA and the Steering Committee members from each state/province
- Needs Assessment with over 100 users from four constituencies:
 - Government Regulatory Staff (i.e., federal, state, provincial, regional and local)
 - Academic Researchers (e.g., atmospheric modeling, deposition monitoring, human and ecological health investigations, etc.)
 - Policy decision-makers and Planners (e.g., EPA, State resource managers, International Joint Commission, etc.)
 - Public Interest Groups (e.g., citizen/community groups, consultants, etc.)

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CAROL - Needs Assessment

- General Findings:
 - All user communities were concerned about integrating repository data within their own analysis/reporting environments
 - All user communities are looking for data to be compatible with open source or commercial GIS desktop and server software
 - Generally looking for less reliance on proprietary software and tools
 - Website response and content richness is important
 - Requirement for better and more complete metadata

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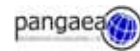
System Design

- CAROL Major Components:
 - Integrated Security Model and Architecture with LDAP Authentication
 - Inventory Query Tools
 - User Feedback Tool and Discussion / Support Forums
 - Data Extraction Tools
 - Data Visualization via Interactive Mapping
 - Customizable Report Generation

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System Design

- Technologies:
 - Oracle 9i
 - Solaris 9
 - ESRI ArcSDE
 - Apache HTTP Server
 - Jakarta Tomcat
 - PHP
 - OpenLDAP
 - University of Minnesota MapServer
 - PHP MapScript
 - Chameleon

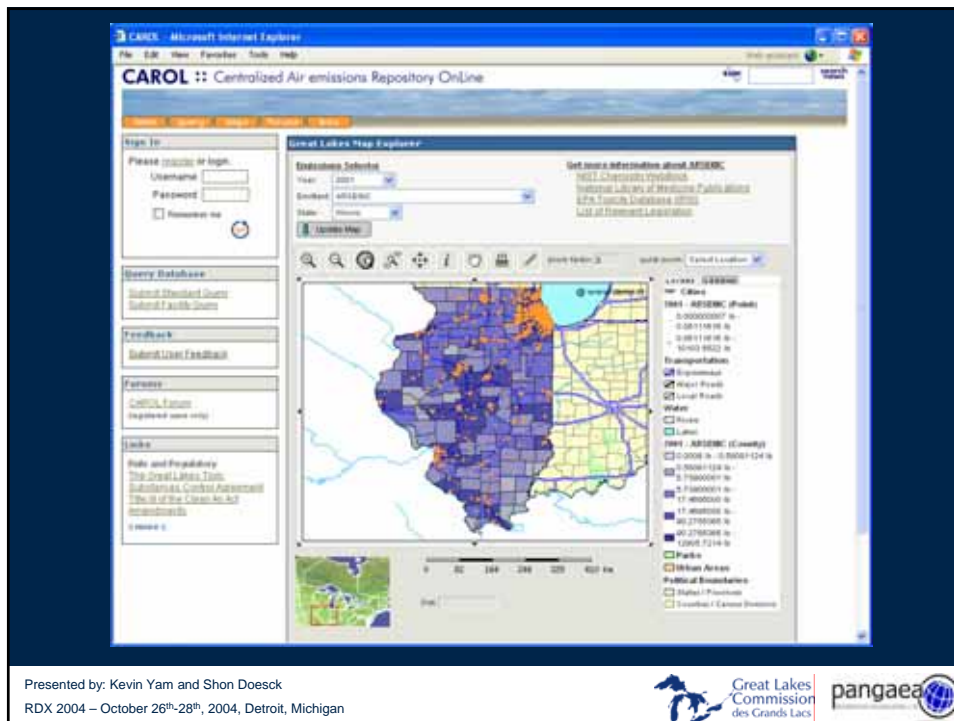
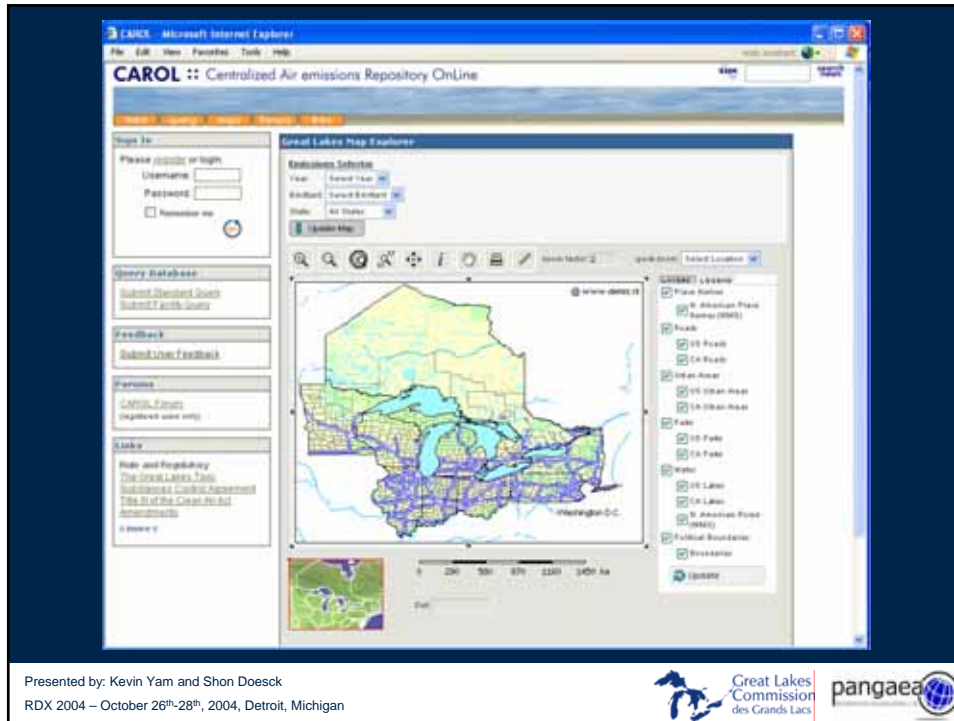
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A screenshot of a web browser displaying the CAROL (Centralized Air emissions Repository OnLine) website. The browser window title is 'CAROL - Microsoft Internet Explorer'. The address bar shows 'http://hdsi.gi.org/online/'. The page content includes a navigation menu with links for Home, About Us, Contact Us, and Help. The main content area is divided into several sections: 'Sign In' with a login form for Username and Password; 'Getting Started' with introductory text and a link to 'CAROL Fact Sheet'; 'Map Explorer' with a map of the Great Lakes region and instructions to 'Click on map to search the Great Lakes Air Toxics Emissions Inventory geographically'; 'Query Database' with a search box; 'Feedback' with a 'Submit Your Feedback' button; 'Forum' with a link to 'CAROL Forum'; and 'Links' with a list of external resources. On the right side, there are additional sections: 'Map Explorer' with a globe icon and text about exploring data layers; 'Visualization' with a camera icon and text about scientific visualization; and 'What's New?' with a text box about the 2003 GLAD RFP. The footer of the browser window shows the URL 'http://hdsi.gi.org/online/' and the Internet Explorer logo.

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Pollutant	Pounds
ACETONITRILE	3001852712
ACETONITRILE	3001852712
ACETALDEHYDE	780649990
ACROLEIN	74000000
ACRYLONITRILE	902247818
AMMONIA	222000
BENZALDEHYDE	301014822
BENZENE	227000
BENZOPHENONE	3001260070
BENZOTRIAZOLONE	3001010112
BENZOTRIAZOLONE	3001230000

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The screenshot shows two browser windows. The left window is the CAROL login page, and the right window displays the '2001 Estimated Emissions by Selected Emittant and Geography' page. The right page includes a table with columns for 'Facid', 'Area', and 'Total'. Below the table is a pie chart titled '2001 Estimated Emissions by Source Category' with segments for 'Other 20%', 'Composite pigments 5%', and 'Fabricated metal products, iron 50%'. A table below the chart lists the following data:

SIC	DESCRIPTION	EMISSIONS (LBS)
3341	Secondary nonferrous metals	2850.51
3313	Fabricated metal products, non	418.00
2812	Composite pigments	210.11
---	Other Sources*	875.87
Total Estimated Emissions:		5,487.71 lbs.

Footnotes: * Data includes emissions estimates for only those geographic areas where data is available. † Other Sources: Individuals see this percentage of the total.

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Web Mapping

- Numerous components required to make all of the web mapping functional
 - Backend: Creating GIS Data out of the massive repository data warehouse!
 - UNIX Shell scripts and Oracle PL/SQL Routines developed that create a series of SQL files and UNIX shell scripts that automatically do the following:
 - Aggregate emissions inventory data up to the Source level
 - Create tables for point sources and county total emissions
 - Spatialize these tables (dbms2sde and ArcSDE Views)
 - Copy these tables to ArcSDE (and register with geodatabase)
 - Create cleanup scripts for the next iteration
 - 231 pollutants monitored x 2 source types x 6 inventory years...

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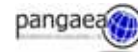
Web Mapping

- Front end components use MapServer / Chameleon
 - Chameleon is an open source, configurable environment for developing web mapping applications
 - Supports OGC standards for WMS, WFS and WMT Viewer Contexts
 - Chameleon is near final release (1.99 beta 2), and has proven to be an excellent development environment
 - <http://chameleon.maptools.org>
 - Thanks DM Solutions!

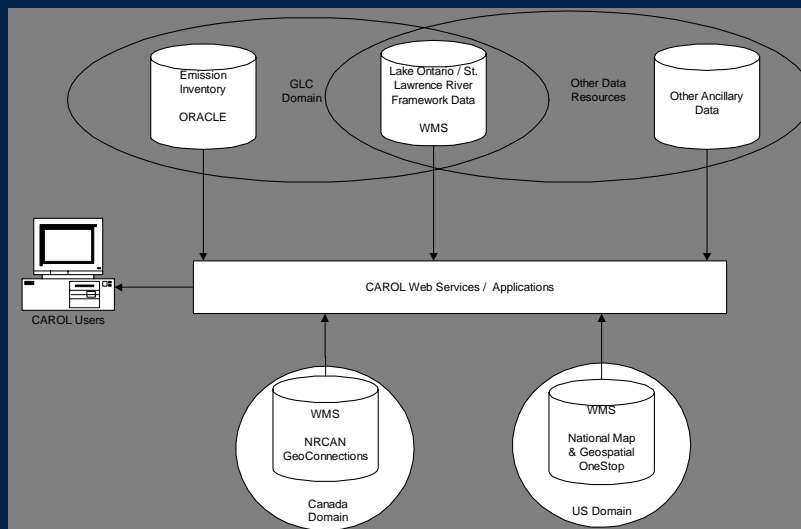
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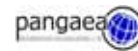
Support of OGC Standards



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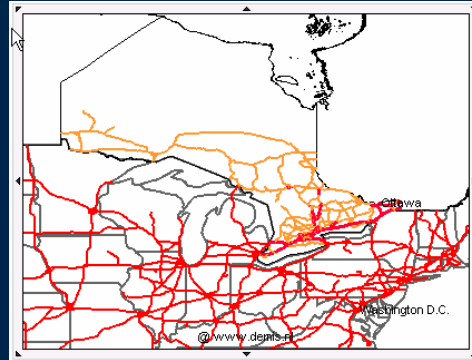


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Web Mapping

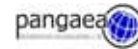
- Downsides to using OGC standards in current CAROL system
 - Support for Styled Layer Descriptor (SLD) is limited in publicly available WMS/WFS services
 - Symbology problems with US/Canadian layers
 - Speed/reliability can be an issue



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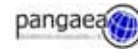
System Benefits

- Improved Annual Reporting
 - Users at all levels of government and the public can quickly and easily generate their own data without relying on hardcopy / PDF
- OpenGIS Integration
 - Greatly expanded accessibility of data on user desktops without need to export/import
- Improved Accessibility and Visualization
 - Query holdings can be viewed in a geographic context!
 - Public can access important, large data store

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Tying it all together...



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