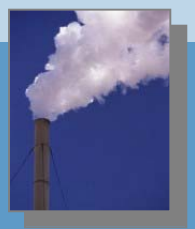
GSA 2002
Implementing Geoinformatics for
Knowledge Integration and Decision Management

The MIDCARB Carbon Sequestration Project:

Midcontinent Interactive Digital Carbon Atlas and Relational DataBase

Kansas Open-file Report 2002-45

Program Participants:



http://www.midcarb.org

October 28, 2002

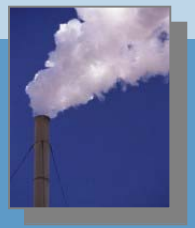
Abstract

MIDCONTINENT INTERACTIVE DIGITAL CARBON ATLAS AND RELATIONAL DATABASE (MIDCARB)

CARR, Timothy R.[1], BARTLEY, Jeremy D.[2], NELSON, Kenneth A. [2], ADKINS-HELJESON, Dana [1], WEISENFLUH, Gerald A. [3], EATON, Nathan [4], KOROSE, Christopher P. [5], and WELLS, Joseph G. [6],

(1) Kansas Geological Survey, Univ of Kansas, 1930 Constant Ave, Lawrence, KS 66047-3726, tcarr@kgs.ku.edu
(2) Kansas Geological Survey, Univ of Kansas, 1930 Constant Avenue, Lawrence, KS 66047-3726
(3) Kentucky Geological Survey, University of Kentucky, Lexington, KY 40506-0107
(4) Indiana Geol Survey, 611 North Walnut Grove, Bloomington, IN 47405-2208
(5) Illinois State Geol Survey, 615 E. Peabody Dr, Champaign, IL 61820
(6) Ohio Div of Geol Survey, 4383 Fountain Square Dr, Columbus, OH 43224-1362

The **Midcontinent Interactive Digital Carbon Atlas and Relational Database (MIDCARB)** is a cooperative project that assembles a consortium of five states (Indiana, Illinois, Kansas, Kentucky and Ohio) to construct an online distributed Relational Database Management System (RDBMS) and Geographic Information System (GIS) covering aspects of carbon dioxide geologic sequestration(http://www.midcarb.org). Geologic sequestration may be one way to safely store carbon over long periods of time, if the proper tools to analyze the geological feasibility as well as the associated costs can be developed. The MIDCARB server provides users the ability to analyze the amount of CO2 available for sequestration in relation to a source, the geologic security and safety of a sequestration site, the long-term effects on a reservoir, and the cost of compression and transport of CO2 between source and sequestration site. The system links the five states of the consortium into a coordinated regional database system consisting of datasets useful to industry, regulators and the public. The project provides advanced distributed computing solutions that dynamically link database servers across the five states so that data can be maintained at the local level but accessed through a single web portal. All data is available to the user and can be queried, assembled, analyzed and displayed. Each individual state has strengths in data gathering, data manipulation and data display, including GIS mapping, custom application development, web development, and database design. Sharing of expertise provides the critical mass of technical expertise to improve CO2 databases and data access in all states. This project improves the flow of data across servers in the five states and increases the amount and quality of available digital data. The MIDCARB project has developed custom online tools to provide real-time display and analyze CO2 sequestration data. Using spatial data engines, Internet map servers and RDBMS operating through a common web-based application links together data from sources, sinks and transportation within a spatial context. Display of both the tabular and spatial information through an online client can assist decision makers by providing flexible access to common sets of high quality data.



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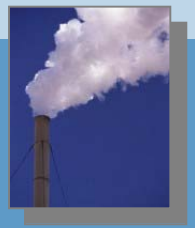
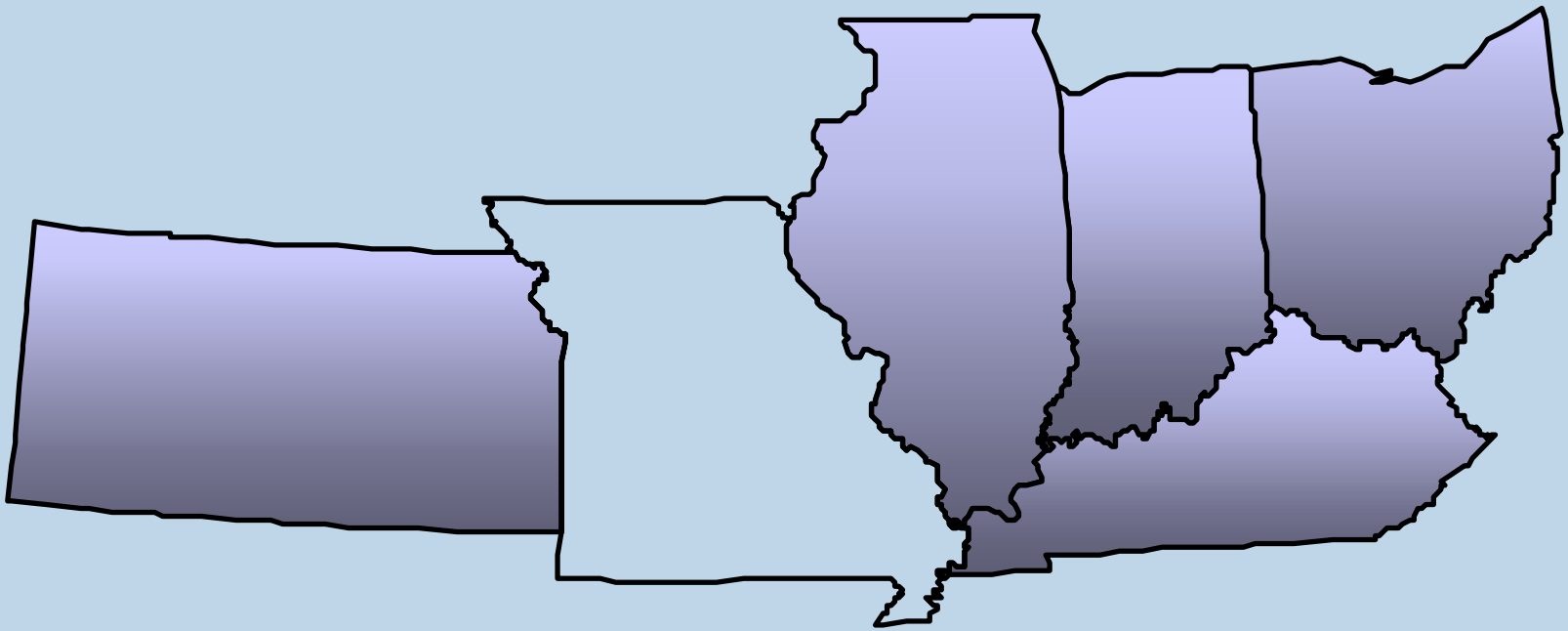
Relevance: Geoinformatics

- To serve data and analysis that satisfies the user
- To have an immediate, significant and direct bearing on the matter at hand
- To provide information that is opportune
- To maintain high quality and current information



MIDCARB Consortium



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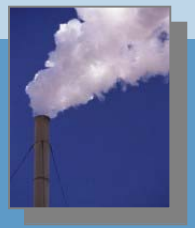
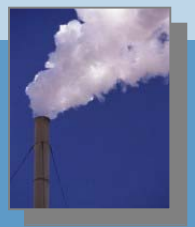
MIDCARB Project Goals:

- Characterize Major CO_2 Sources
  - Quantity, Quality, Location
- Characterize Potential Sequestration Sites
  - Geology and Reservoir Characteristics
- Develop Relational/Spatial Databases
  - Local and Regional Reporting Levels
- Supply Data to the Public
  - For use as tools in cost/feasibility analyses, etc.



Data Connectivity Options:

- Store and serve all data layers from one central server
  - Maintenance issues
- Create database views to join tables remotely
  - Difficult with different RDBMS software packages
- Join remote tables and layers via a Internet Map Server and other web application tools to build dynamic web pages.
  - Easy, flexible, and it works!



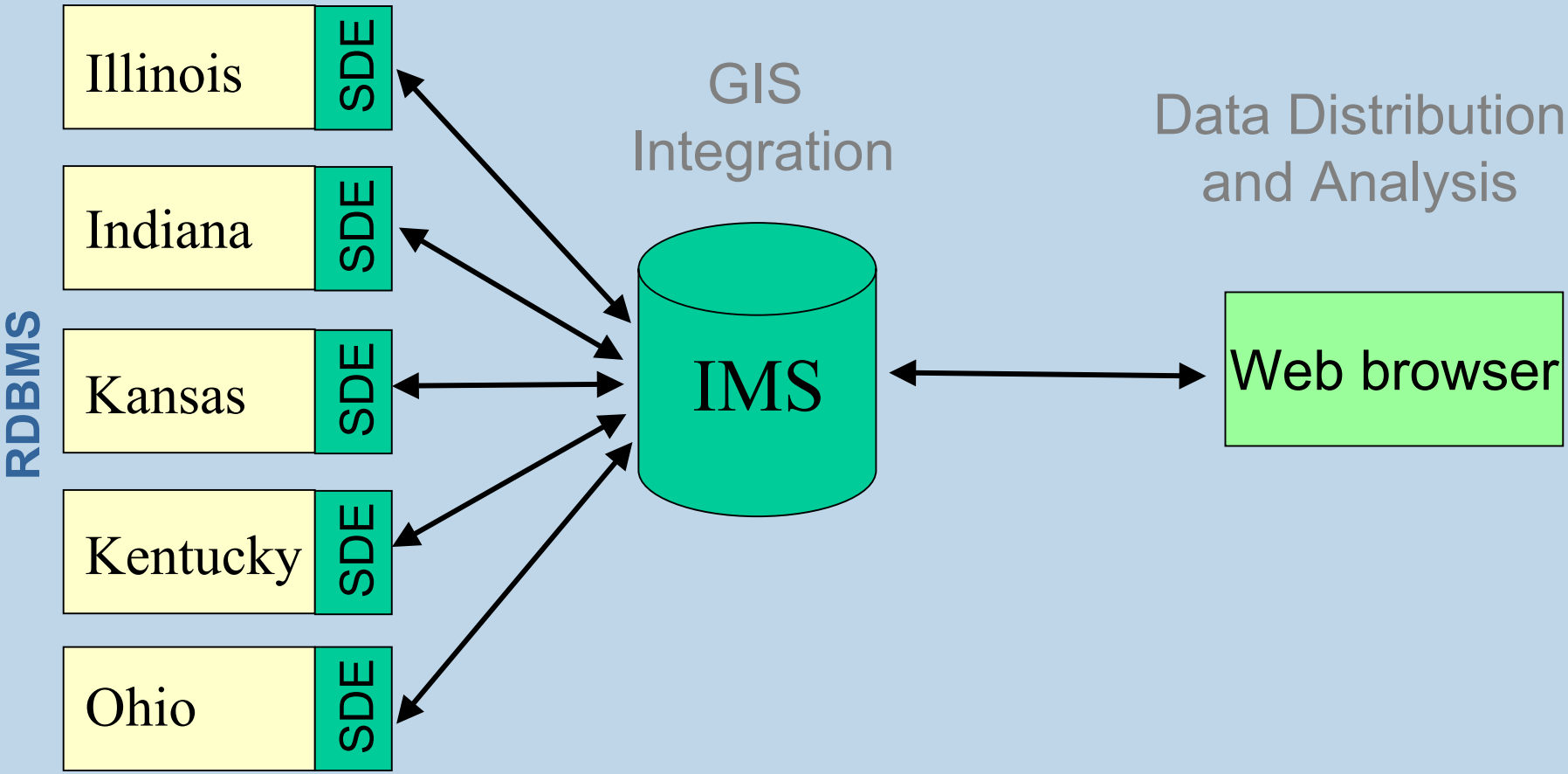
Database Structure:

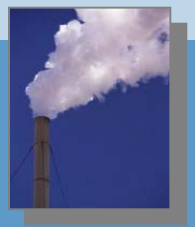
- Each organization maintains their own data layers according to their own database design and formats.

- A MIDCARB structure for database themes is under continuous construction to define what data elements are necessary and how the information will be presented to the user

- Implement database views rather than alter the table structure to adhere to centralized database standards

Spatial Database Connections





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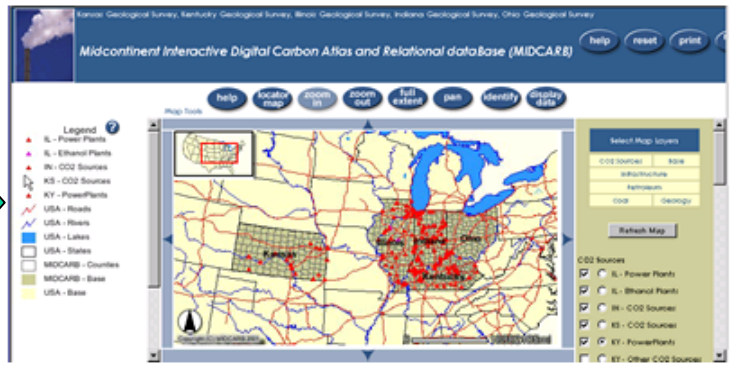
MIDCARB - Map Server Deployment

The Midcontinent Interactive Digital Carbon Atlas and Relational DataBase (MIDCARB) is a joint project between the Geological Survey's of Illinois, Indiana, Kansas, Kentucky, and Ohio, with funding from the Department of Energy National Energy Technology Laboratory. The purpose of MIDCARB is to enable the evaluation of carbon sequestration potential in these states. When completed, the digital spatial database will allow users to estimate the amount of carbon dioxide (CO_2) emitted by source supplies (such as power plants, refineries and other fossil fuel consuming industries) in relation to geologic reservoirs that can provide safe and secure sequestration over geologic periods of time.

Click the map to access the graphical interface to the data:

The long-term effects on a reservoir will be provided and the user will be able to calculate the cost to compress and transport CO_2 between source and sequestration sites. MIDCARB will organize and enhance the critical information about CO_2 sources, and develop the technology needed to access, query, model, analyze, display, and distribute natural-resource data related to carbon management.



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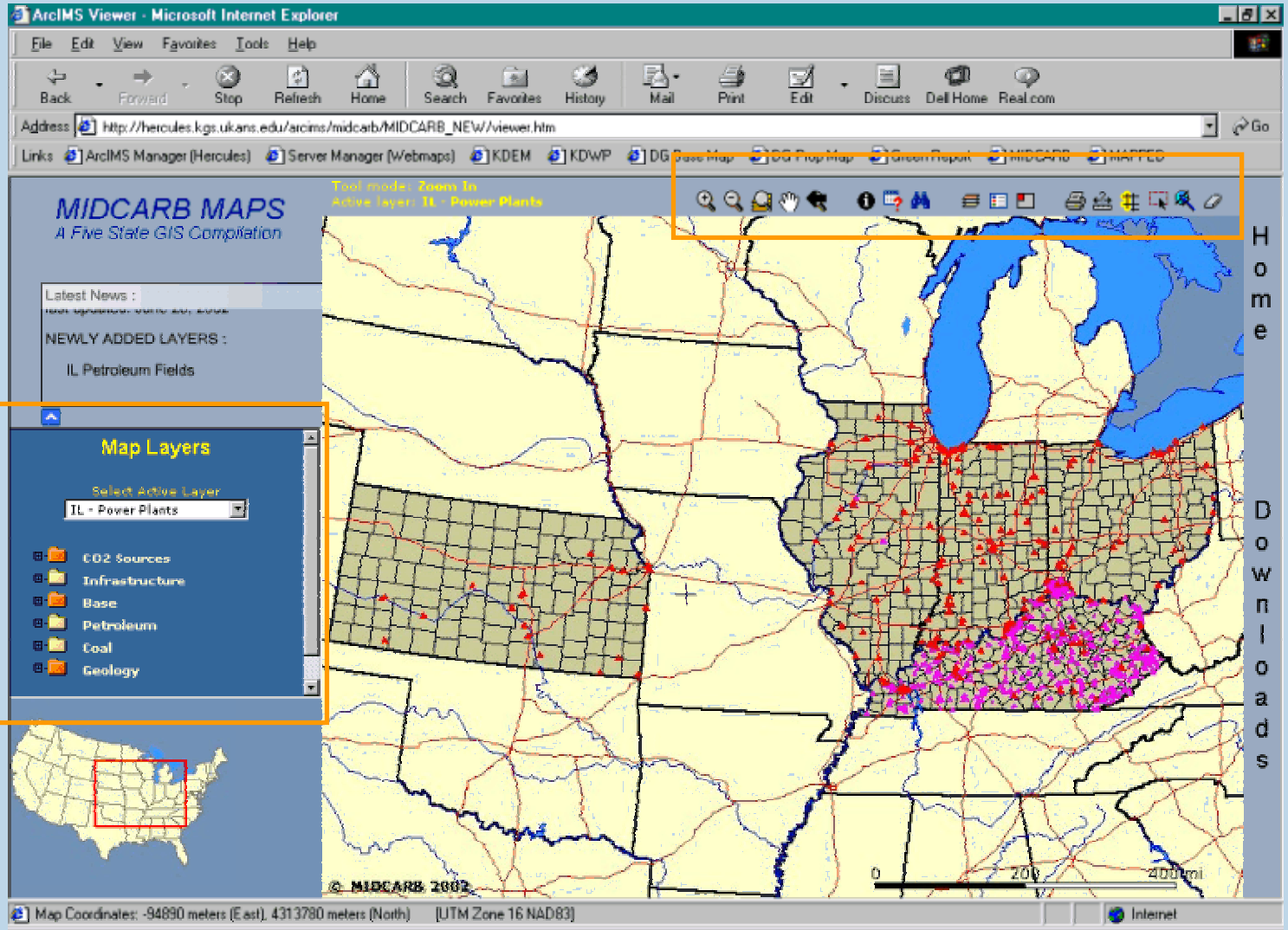
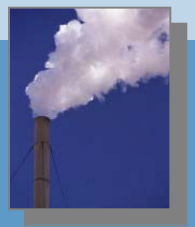
MIDCARB Client Evolution Stage 3 :



Legend/Layer Controls

Toolbar



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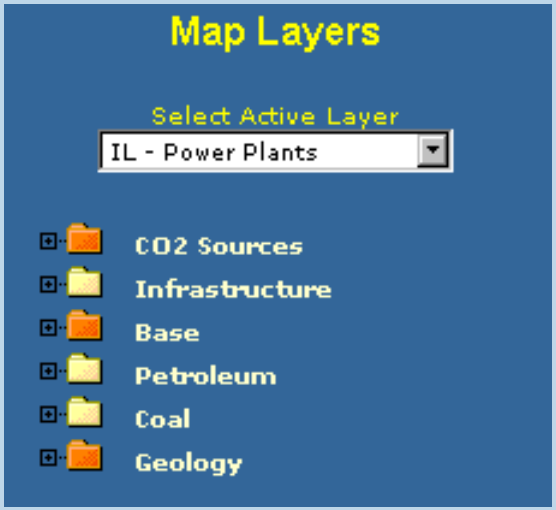
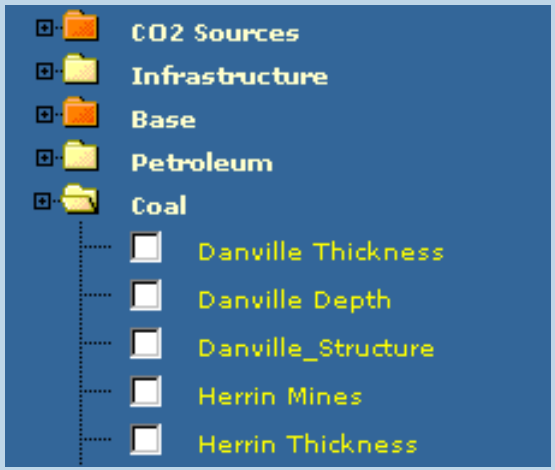
MIDCARB IMS Client – Legend Customization



Expandable database folders organize layers into thematic categories



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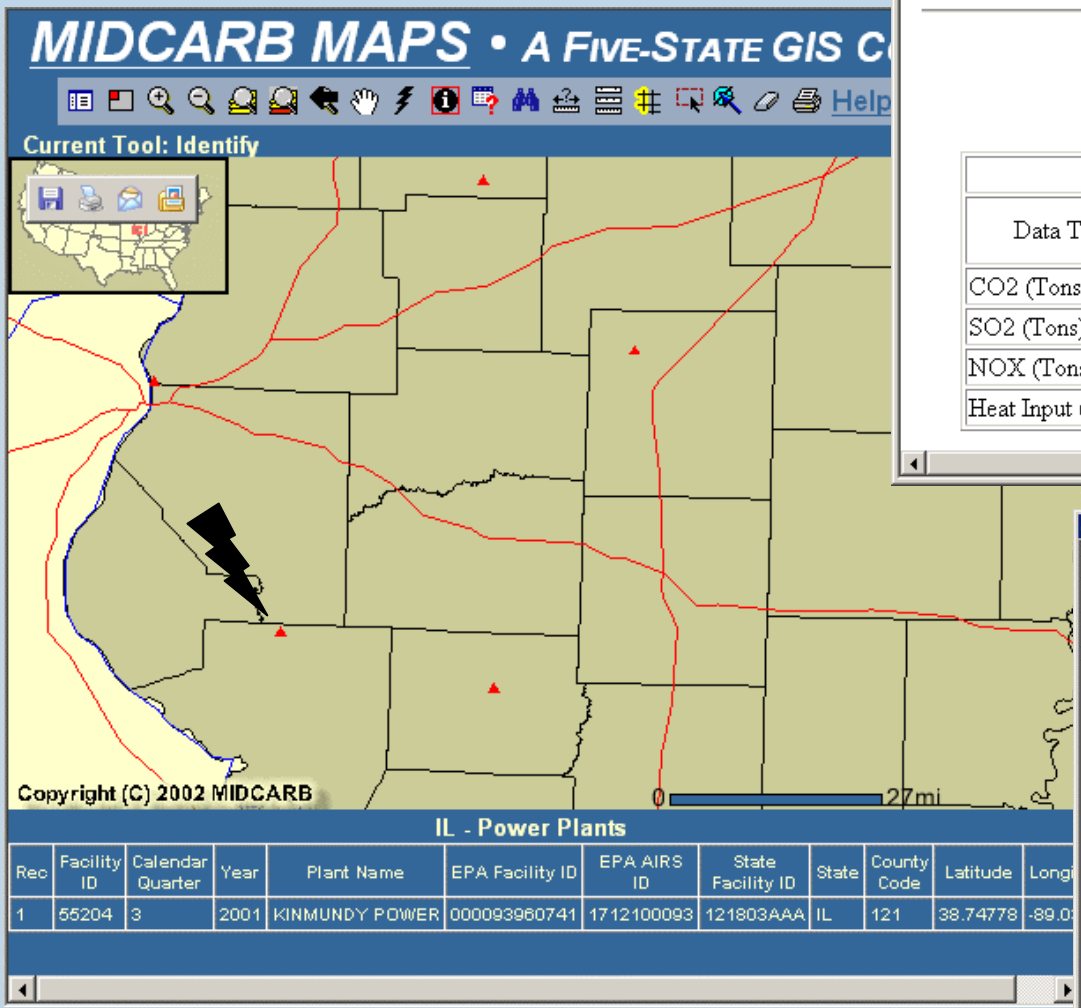
Tabular Data A



MIDCARB--Generating Facility Emissions - Microsoft Internet Explorer

Illinois

PINCKNEYVILLE POWER

Also available is a summary of total Illinois emissions

Unit: CT01; Turbine: Combustion turbine
Rated Capacity (MWe): 49 **Plant Operation Start:** Jun 4, 2000

Most Recent Data			
Data Type	Quarterly totals Apr 9, 2002	Cumulative for 2002	
CO2 (Tons)	207.30	207.30	Make Chart
SO2 (Tons)	0.00	0.00	Not enough data to chart.
NOX (Tons)	.11	.11	Make Chart
Heat Input (mmBtu)	3,487.00	3,487.00	Make Chart

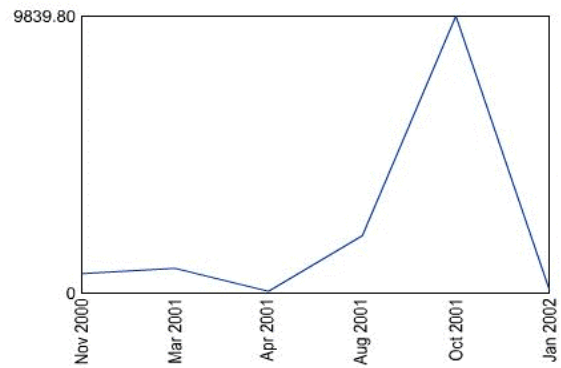
MIDCARB--Illinois--Emissions Charts - Microsoft Internet Explorer

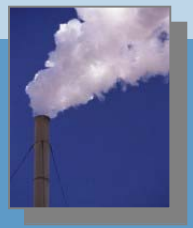
Illinois

PINCKNEYVILLE POWER

Unit: CT01; Turbine: Combustion turbine
Rated Capacity (MWe): 49 **Plant Operation Start:** Jun 4, 2000 **Most Recent Data:** 1-2001

CO2 Tons Quarterly





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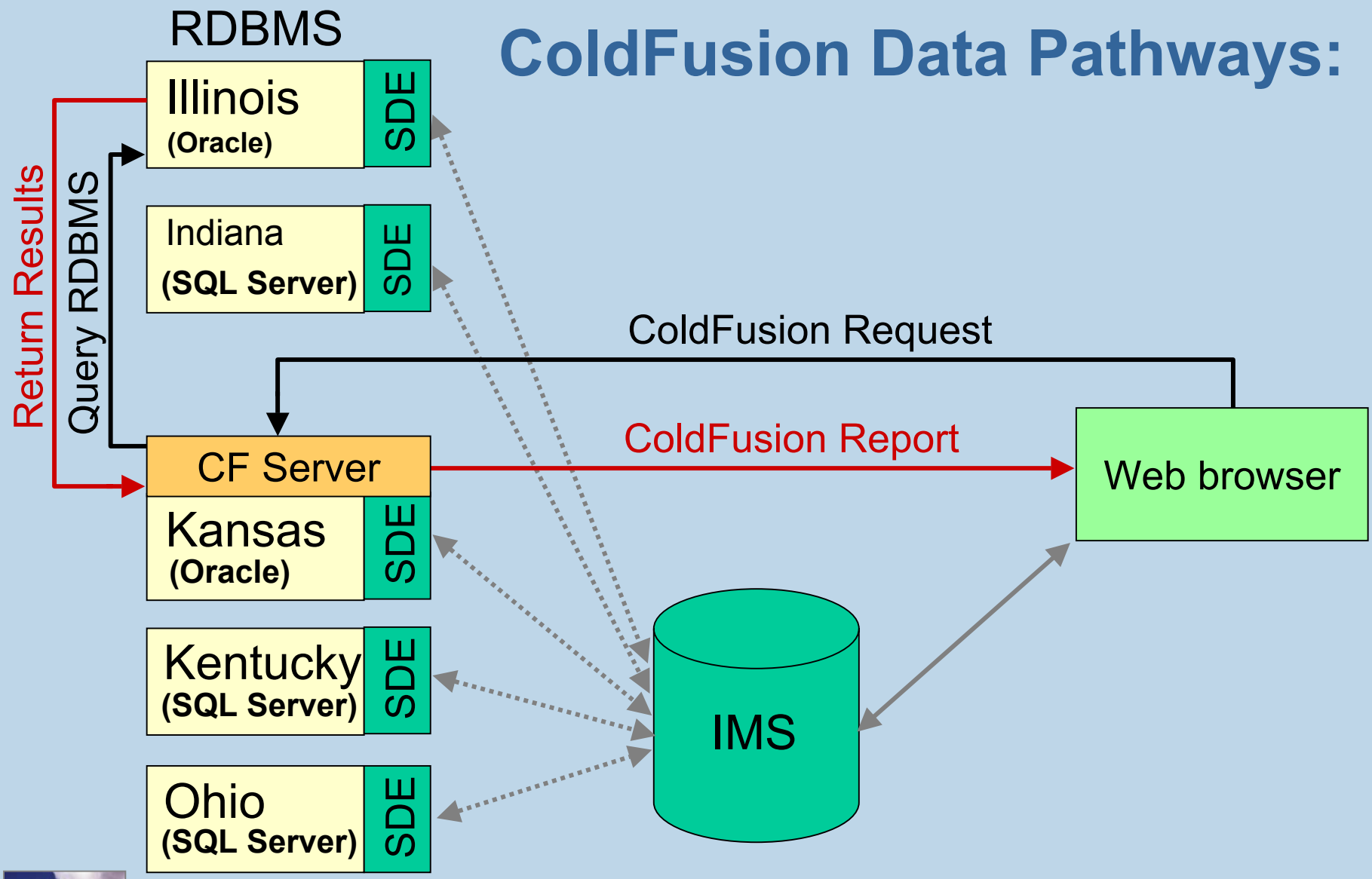
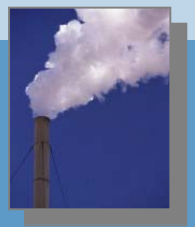
ColdFusion Data Pathways:





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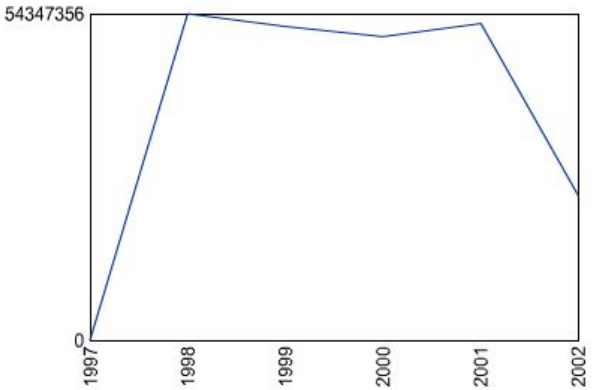
Tabular Data Computation:

MIDCARB--Generating Facility Emissions - Microsoft Internet Explorer

Summary of Illinois Statewide Emissions

Select type: CO2 || SO2 || NOX || Heat Input

CO2 Tons--All Illinois Plants

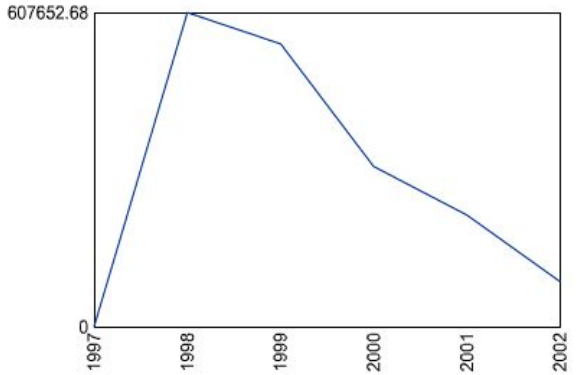


MIDCARB--Generating Facility Emissions - Microsoft Internet Explorer

Summary of Illinois Statewide Emissions

Select type: CO2 || SO2 || NOX || Heat Input

SO2 Tons--All Illinois Plants



Unit: CT01; Turbine: Combustion turbine

Rated Capacity (MWe): 49
Plant Operation Start: Jun 4, 2000

Most Recent Data			
Data Type	Quarterly totals Apr 9, 2002	Cumulative for 2002	
CO2 (Tons)	207.30	207.30	Make Chart
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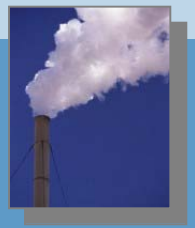
NOX (Tons)	.11	.11	Make Chart
Heat Input (mmBtu)	3,487.00	3,487.00	Make Chart

http://www.midcarb.org

MIDCARB Databases

- Major CO_2 Sources
  - Quantity, Quality, Location
- Transportation Infrastructure
  - Pipelines, Electric Lines
- Base
  - Roads, Rivers, Political Boundaries, DOOQ's, etc.
- Potential Petroleum Sequestration Sites
  - Reservoir Characteristics, Production, Wells
- Potential Coal Sequestration Sites
  - Structure, Thickness,
- Potential Aquifer Sequestration Sites
  - Structure, Thickness, Geochemistry
- General Geology



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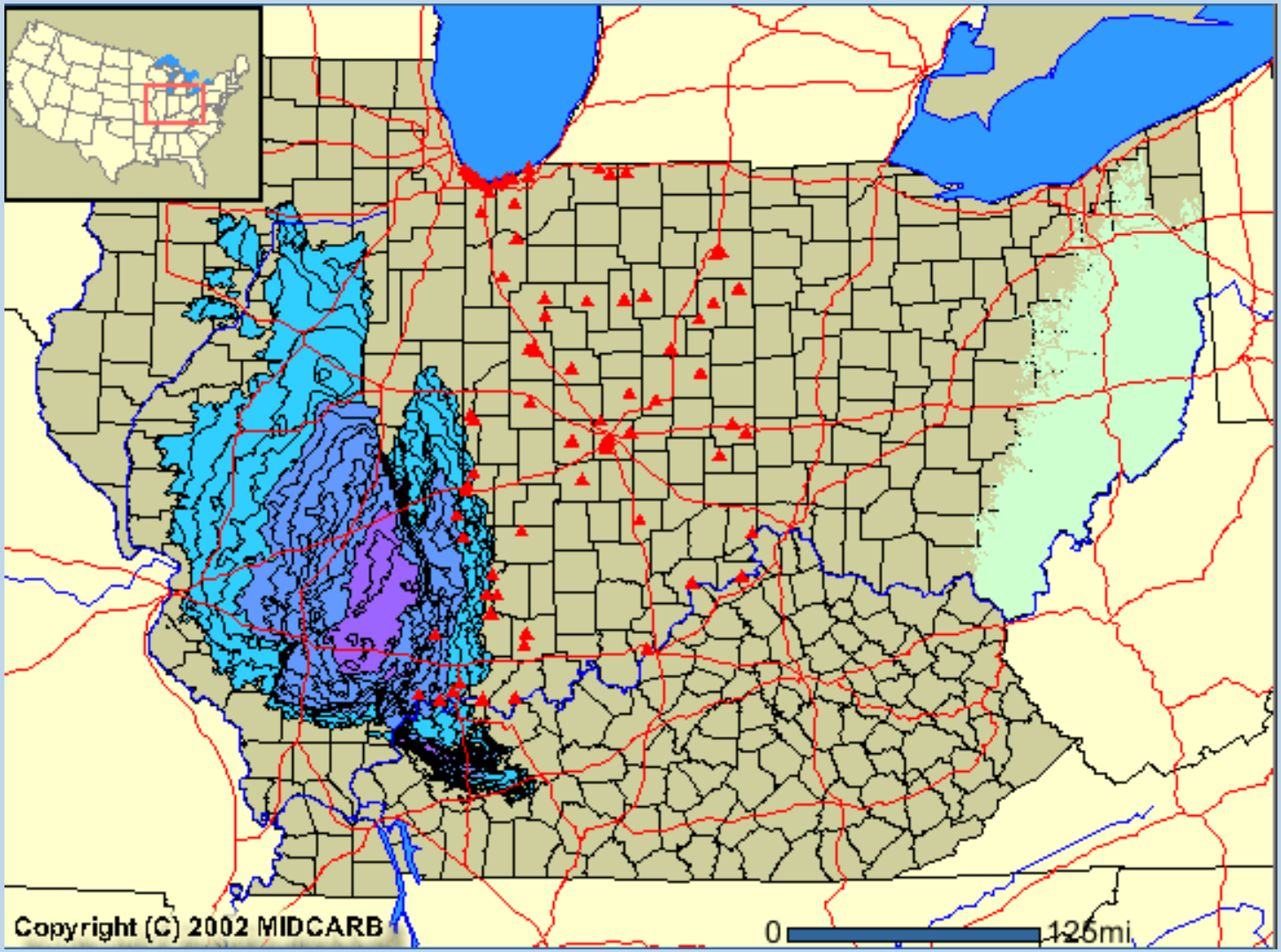
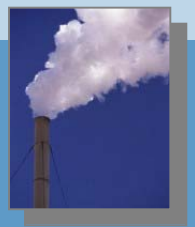
Distributed Coal Themes:





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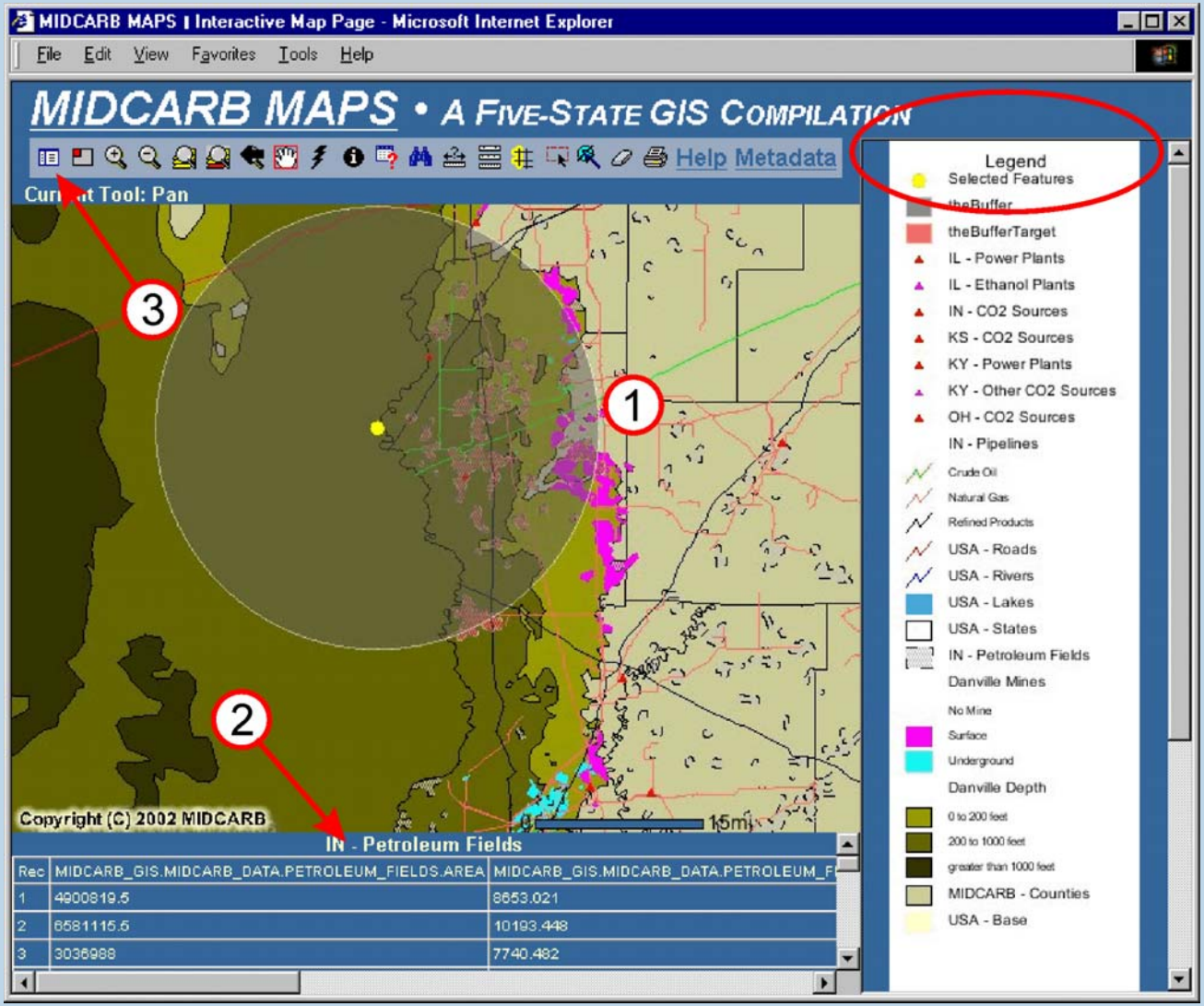
MIDCARB Browser - Tools



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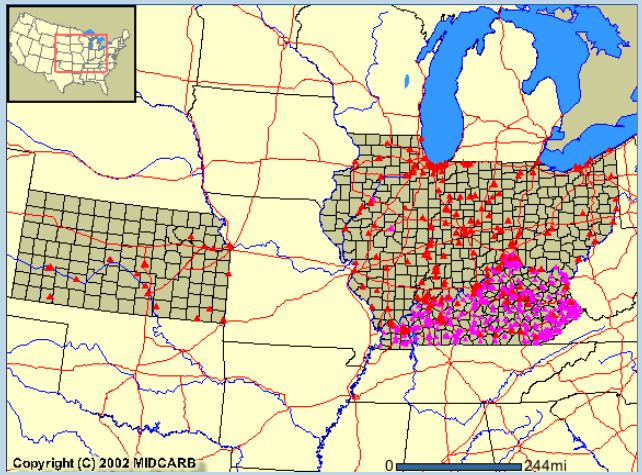
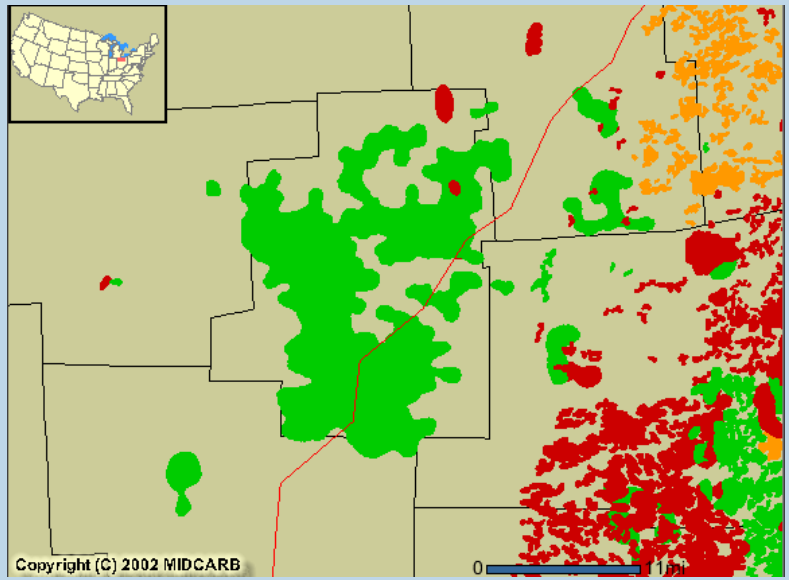
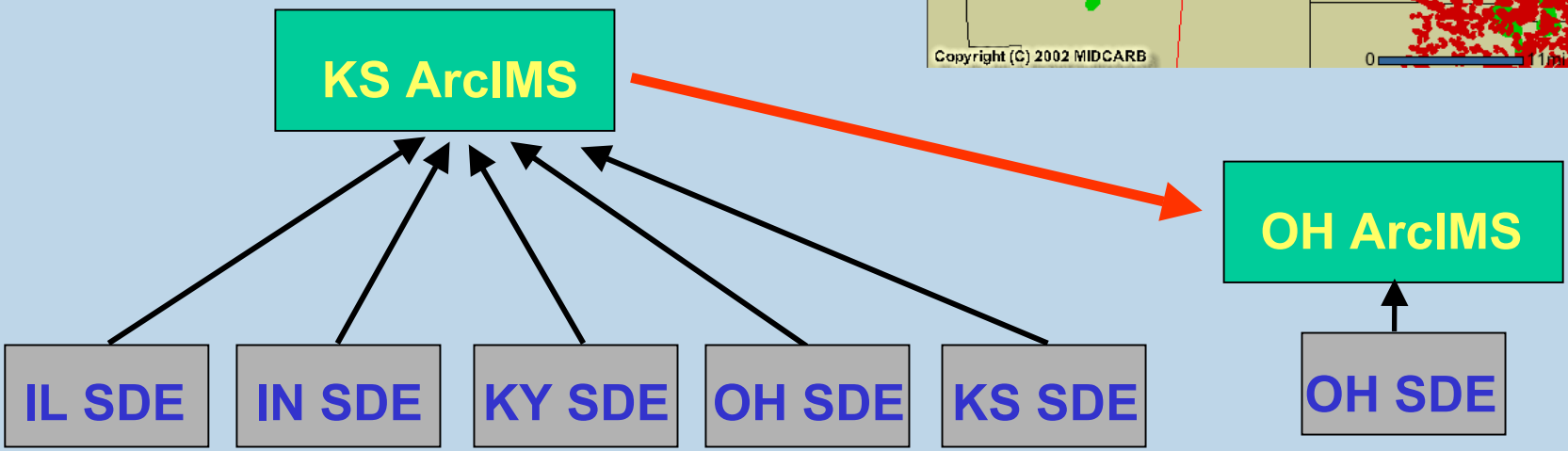
MIDCARB Browser - Level of Detail:







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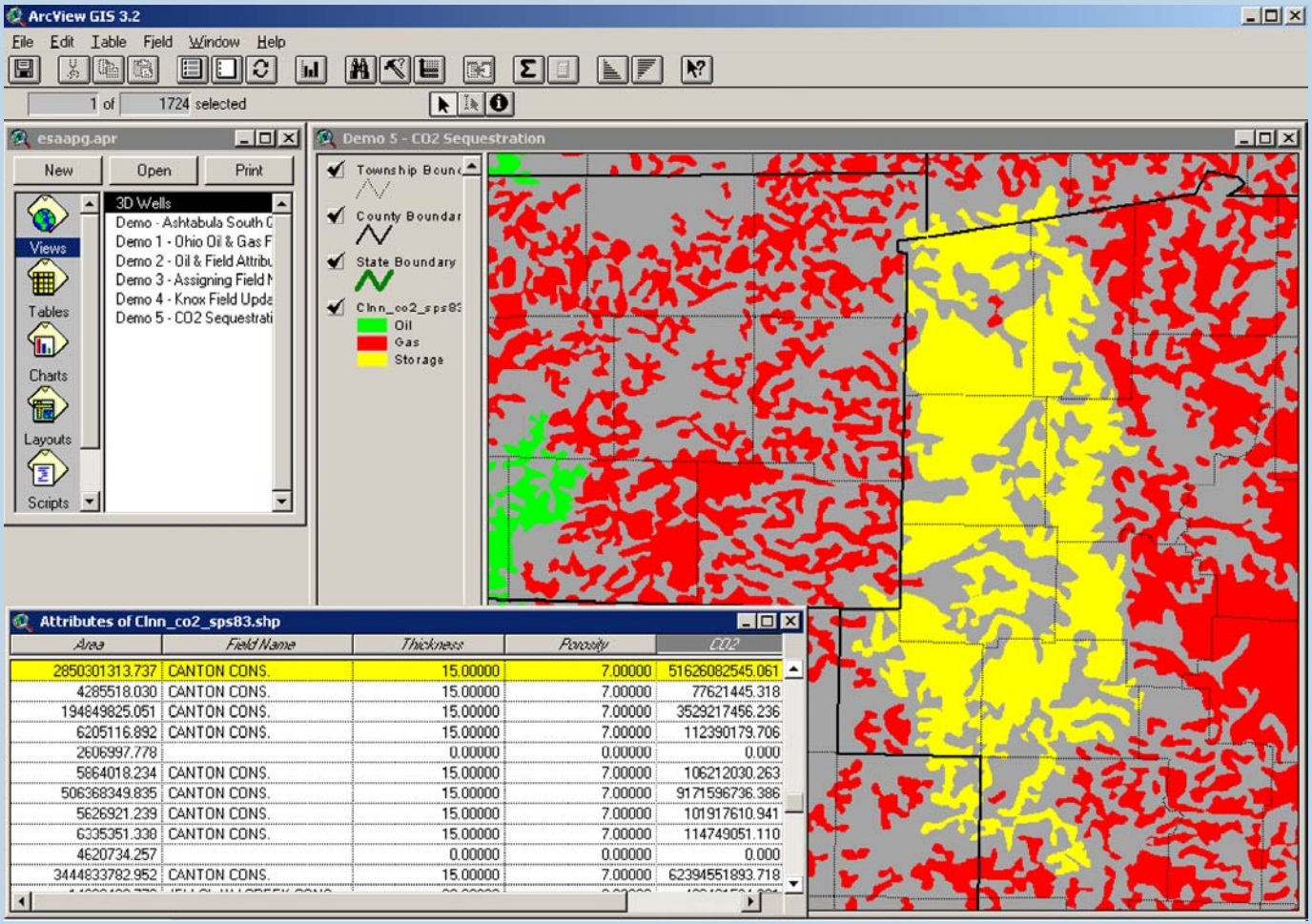
MIDCARB Browser – Local Computations:



OH ArcIMS

OH SDE

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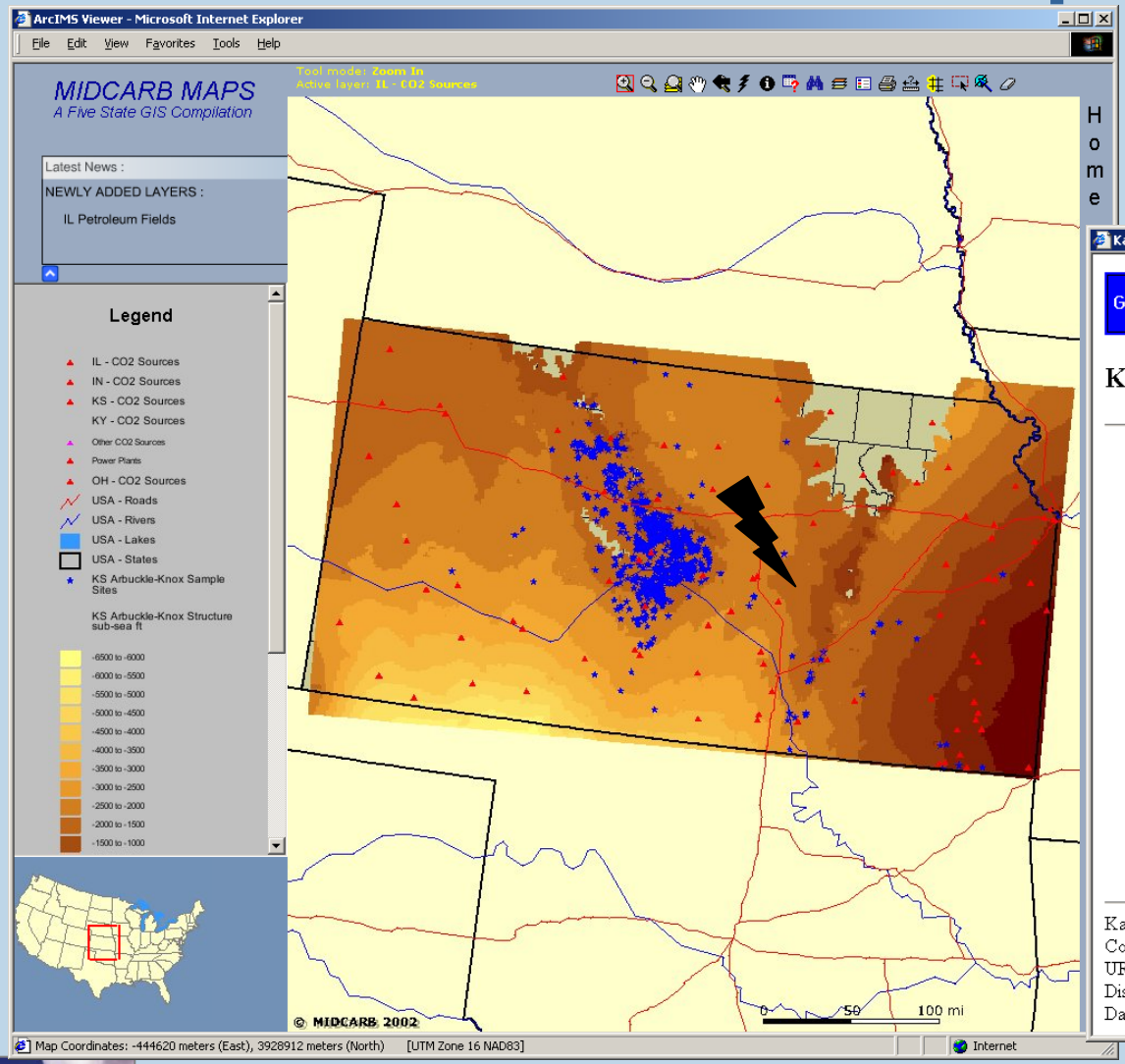
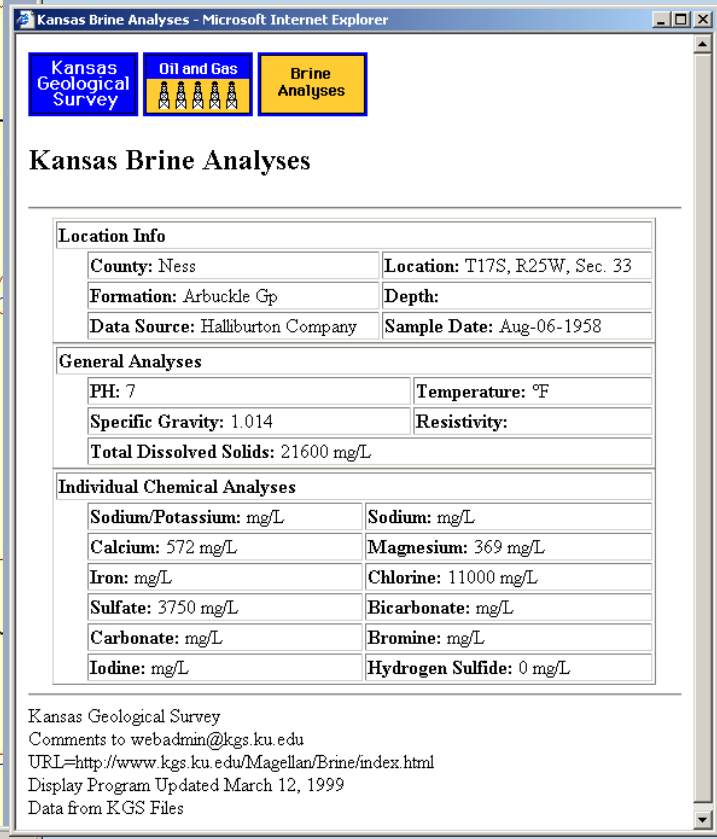
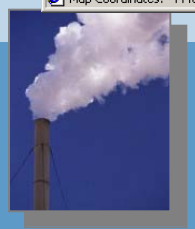
MIDCARB Browser - Aquifers







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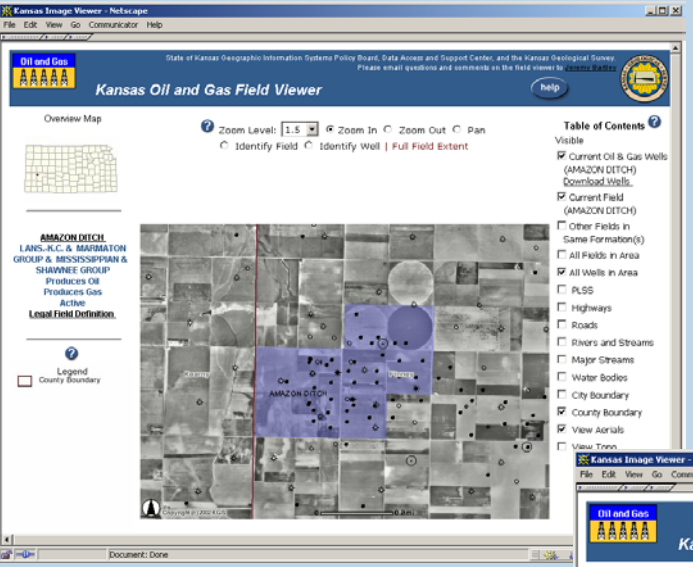
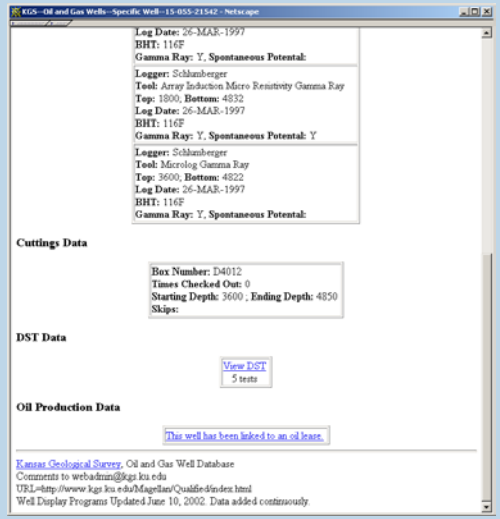
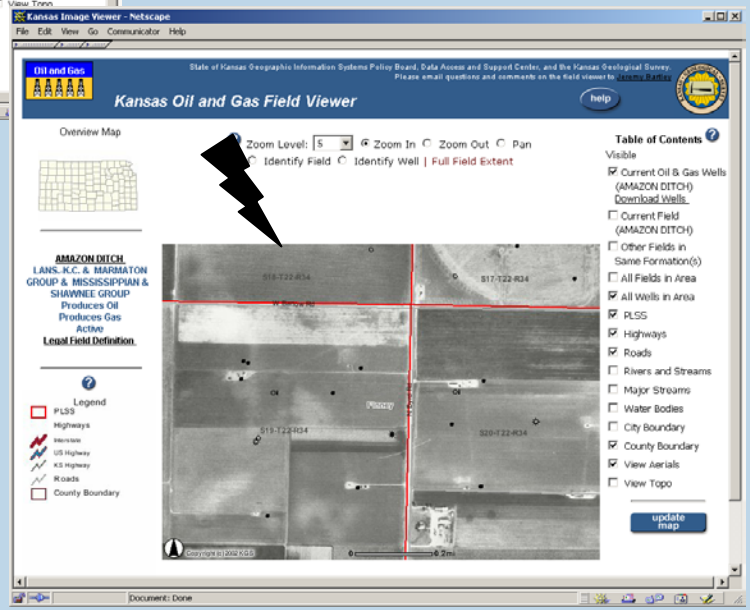
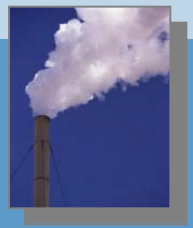
MIDCARB Browser - Oil & Gas









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Metadata Access:

MIDCARB MAPS • METADATA/DATA DOWNLOAD

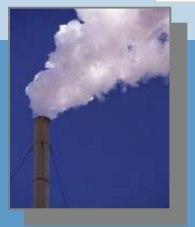
Datasets download
Follow the links in the table below to access metadata and download GIS datasets. GIS datasets are provided as zipped ESRI shapefiles. Refer to the metadata to determine layer projection and datum. The blue column indicates the source location of each dataset.

Warning
The recipient of the data assumes all responsibility for assuring the fitness of the data for the intended purpose. The data are provided electronically as a courtesy. Please contact the owners of the data for comment; the sources for the datasets may be found in the metadata.

CO_2 Sources	Infrastructure	Base Layers
Petroleum	Coal	Geology

CO_2 Sources

IL - Sources	IL SDE	EPA_FAC_IL	shapefile (10 KB)
IL - Ethanol Plants	IL SDE	IL_ETHANOL_PLANTS	not available
IN - Sources	IN SDE	IN_CO2_SOURCES	shapefile (7 KB)
KS - Sources	KS SDE	KS_CO2_SOURCES	not available



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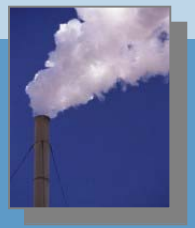
Application Management Tools:
(*Under Construction)*

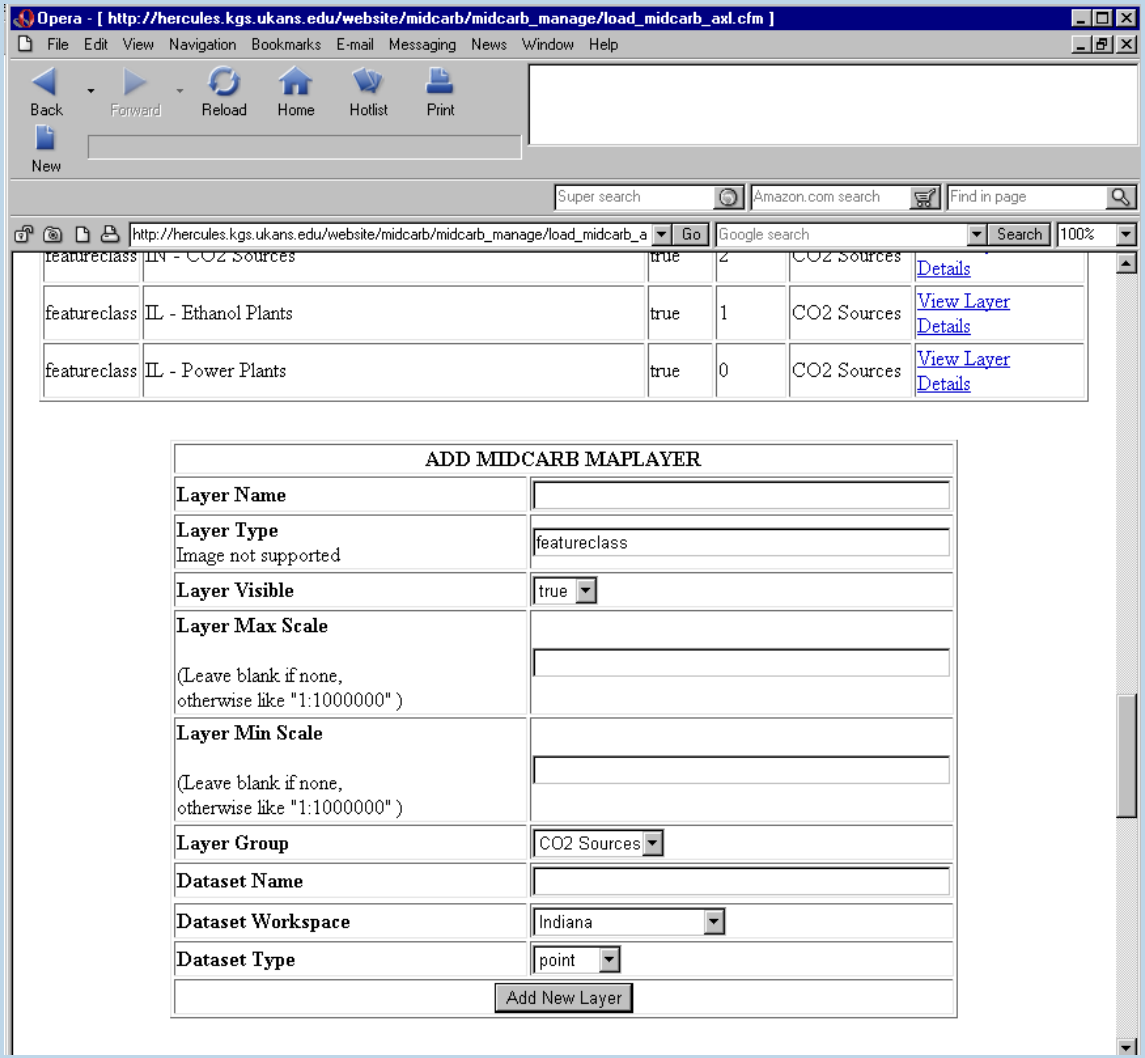
- ColdFusion based application that stores the ArcXML (AXL) file in RDBMS -- Completed

- Password protected site that allows the user to make modifications to the MIDCARB XML file(s) and refresh the map service(s) -- Completed

- Automated procedure that pings the MIDCARB map services to see if they are alive, alerts system administrators if there is problem, and dynamically routes traffic to the backup map server if necessary



Distributed Application Management Utilities:



Allows user to define the properties of a map service and store the property definition in an RDBMS table

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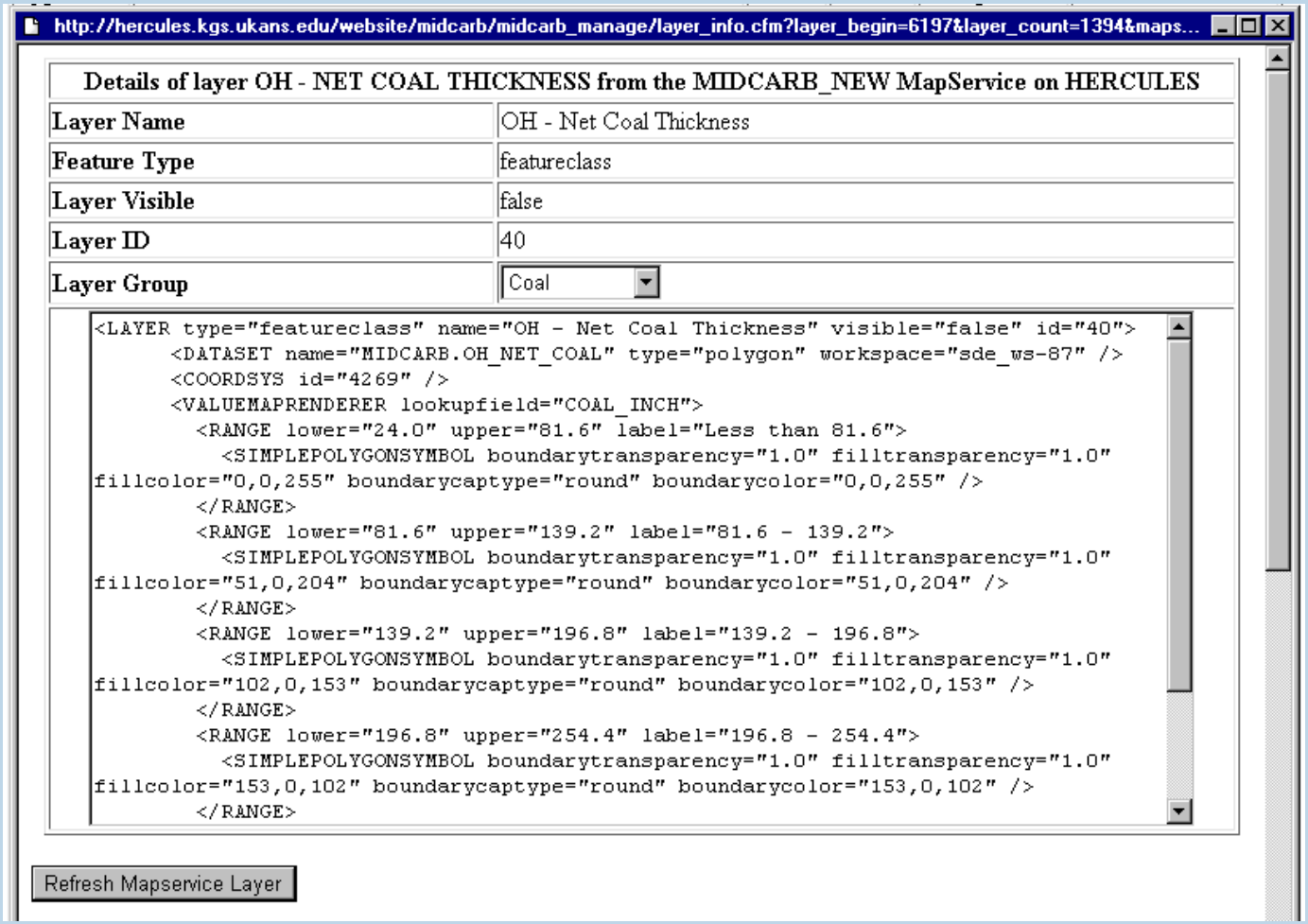
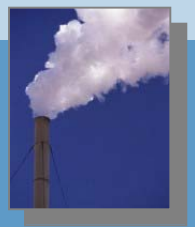
Distributed Application Management Utilities:



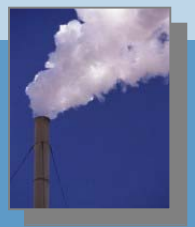
Allows user to modify properties of layer running on an IMS server



http://www.midcarb.org

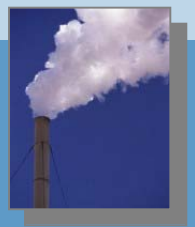
Future System Work

- Pre-IMS layer selection tool to simplify the TOC/Legend
- Implement new metadata server (ArcIMS 4.0)
- Design advanced query tools to analyze the spatial relationship between CO2 sources and sinks
- Complete application management tools
- Explore XML client options (OpenGIS)
- Add additional organizations



Future Content Work

- More Isopach, Depth and Structure Maps
  - Covering Major Oil & Gas Reservoirs, Coals, Aquifers, Shales
- Reservoir Volumetric Parameters
  - MMP, Coal Adsorption, Perm, Porosity
- Detailed Field and Well Data
- Improved Coverage on CO2 Sources
  - Ethanol, Refineries, Cement, Other Industrial Sources



http://www.midcarb.org