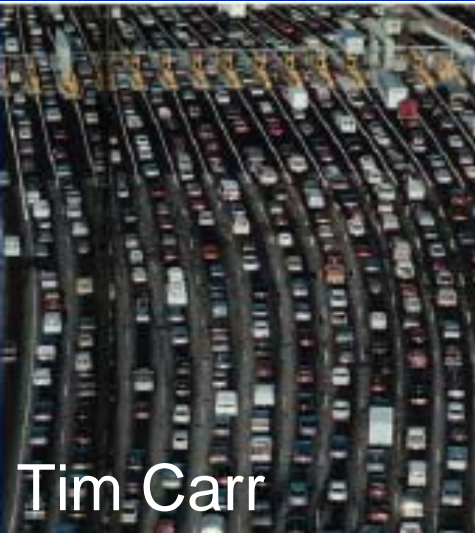


NATional CARBon Sequestration Database and Geographic Information System (NATCARB)

A Step Toward a Carbon Sequestration Cyberinfrastructure



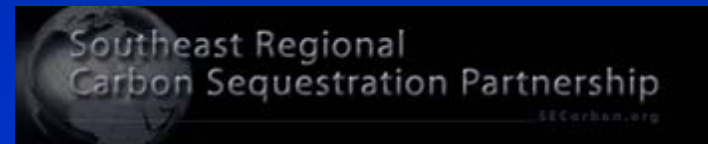
NatCarb Over-Arching Goals



- Connection
 - Bring Society Together with Possible Solutions
 - Complete Online Access to Information & Tools
 - » Expert, Decision Maker, General Public
- Complexity
 - Harder to Display
 - Harder to Analyze (Integrate Data with Models)
 - Harder to Manage
- Coordination
 - Bring the Players Together
 - Bring the Data Together

Provide Basis for Better Policies and Decisions

Regional Partnerships

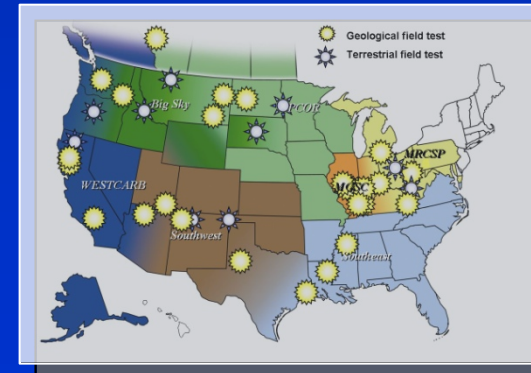


NatCarb a Geoportal Linking Partnerships

Characterize National Potential for Broad-Scale Carbon Sequestration

Role of Distributed GIS:

- * National Carbon Atlas of Carbon Sources and Potential Sinks
- * Decision Support Tools for Analysis and Visualization
- * Management Support Tools to Expand Data and Model Warehouses
- * Support for Field Validation
- * Education and Outreach



Distributed GIS as Glue



GIS Manager 1



GIS Manager 2



GIS Manager 2

Web Server

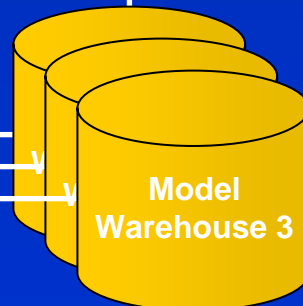
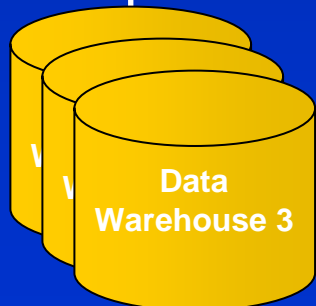


Map Server

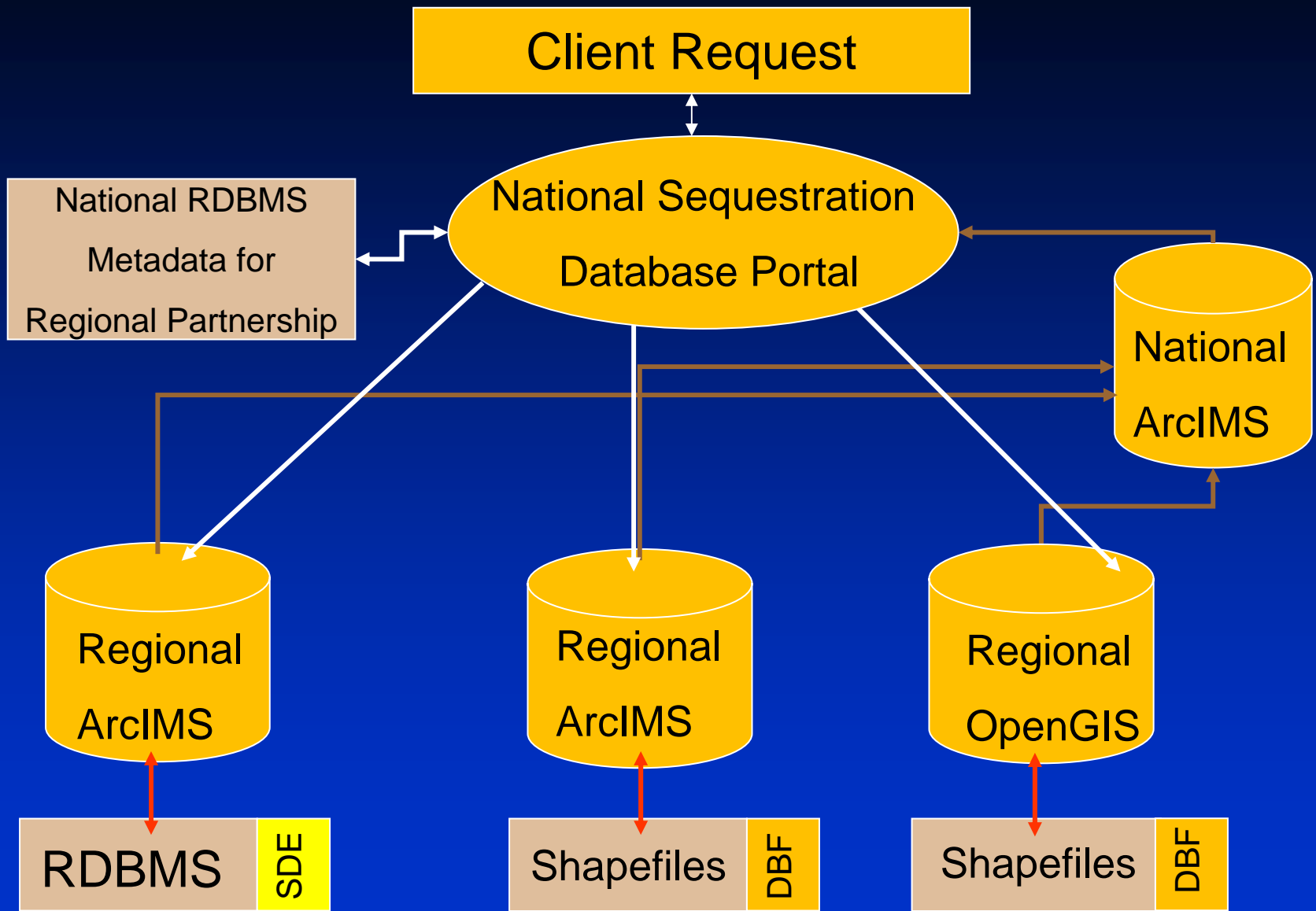


Metadata Server

Knowledge Bases



Public & Decision Makers



NatCarb Home Page

NatCarb
a national look at carbon sequestration
NETL

▶ ATLAS START

▶ CLIMATE CHANGE

▶ SEQUESTRATION

▶ PARTNERSHIPS

▶ SOURCES

▶ SINKS

▶ INTERACTIVE MAP

▶ DATA FILES

National Carbon Explorer

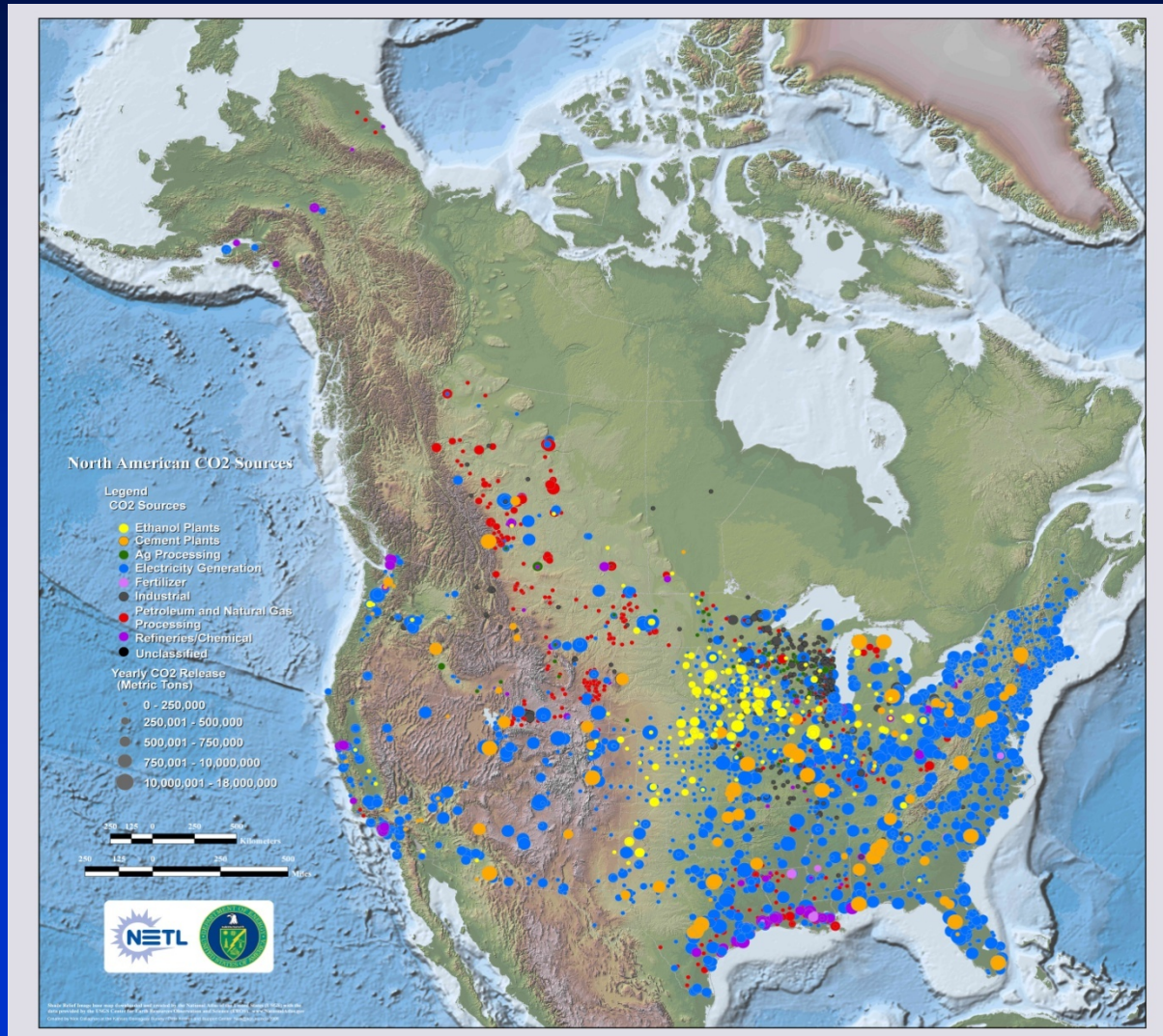
The process of sequestering carbon dioxide (CO₂) involves identifying **sources** that produce CO₂ and **sinks** where the CO₂ can be stored. These web pages present interactive maps and background information on the process of storing CO₂. This Atlas is created by the NatCarb project and sponsored by the U.S. Department of Energy's National Energy Technology Laboratory.

Use the links at left to explore climate change, common sources of greenhouse gasses, and the many ways those gases can be removed from the atmosphere and stored. The [complete atlas](#) is available from the [National Energy Technology Laboratory](#)

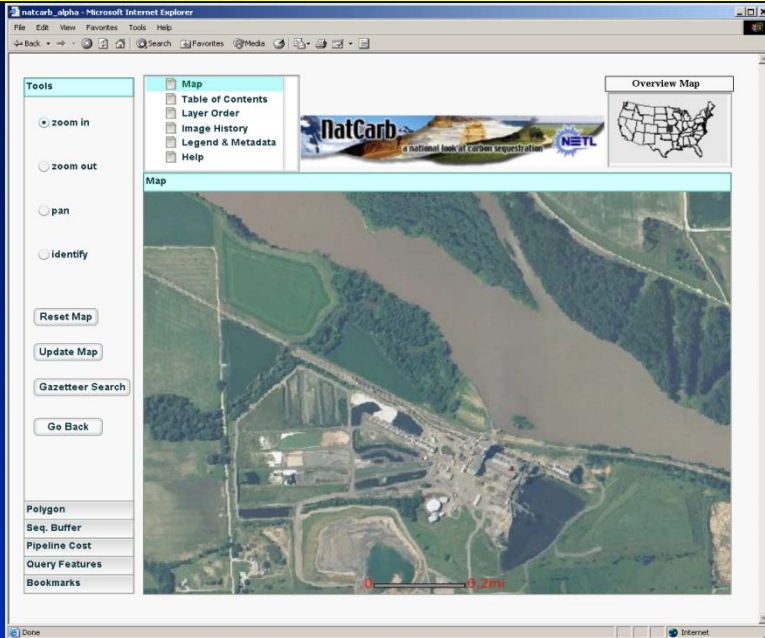
Also available online is additional information on the [NatCarb Project](#), whose goal is to create a national view of carbon sequestration by linking regionally managed databases. The main site includes the original [NatCarb Interactive Map](#), a more robust version of the maps presented in the new Atlas linked at left.

This server is run by the [Kansas Geological Survey](#) for NatCarb, a project funded by the U.S. Dept. of Energy's [National Energy Technology Laboratory](#).
This page Updated March 29, 2007.
The URL for this page is <http://www.natcarb.org/index.html>
Comments to webadmin@kgs.ku.edu
[Photo Credits](#)
[Disclaimer](#)

National Atlas- Sources

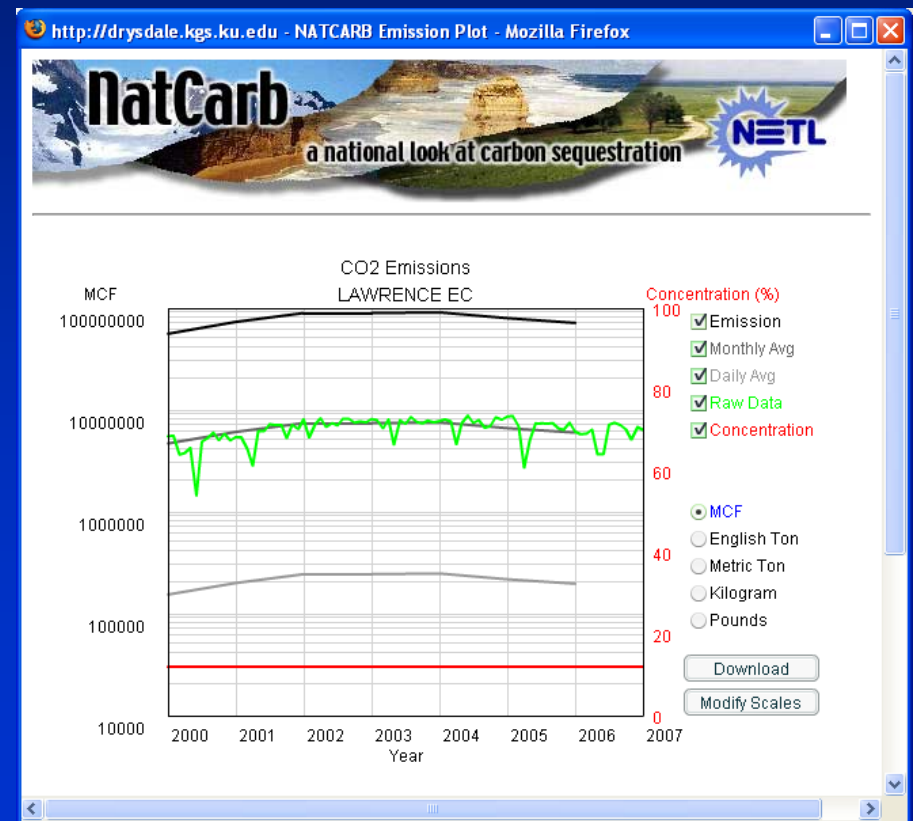


Display and Analysis



From
Local
View

To Analysis



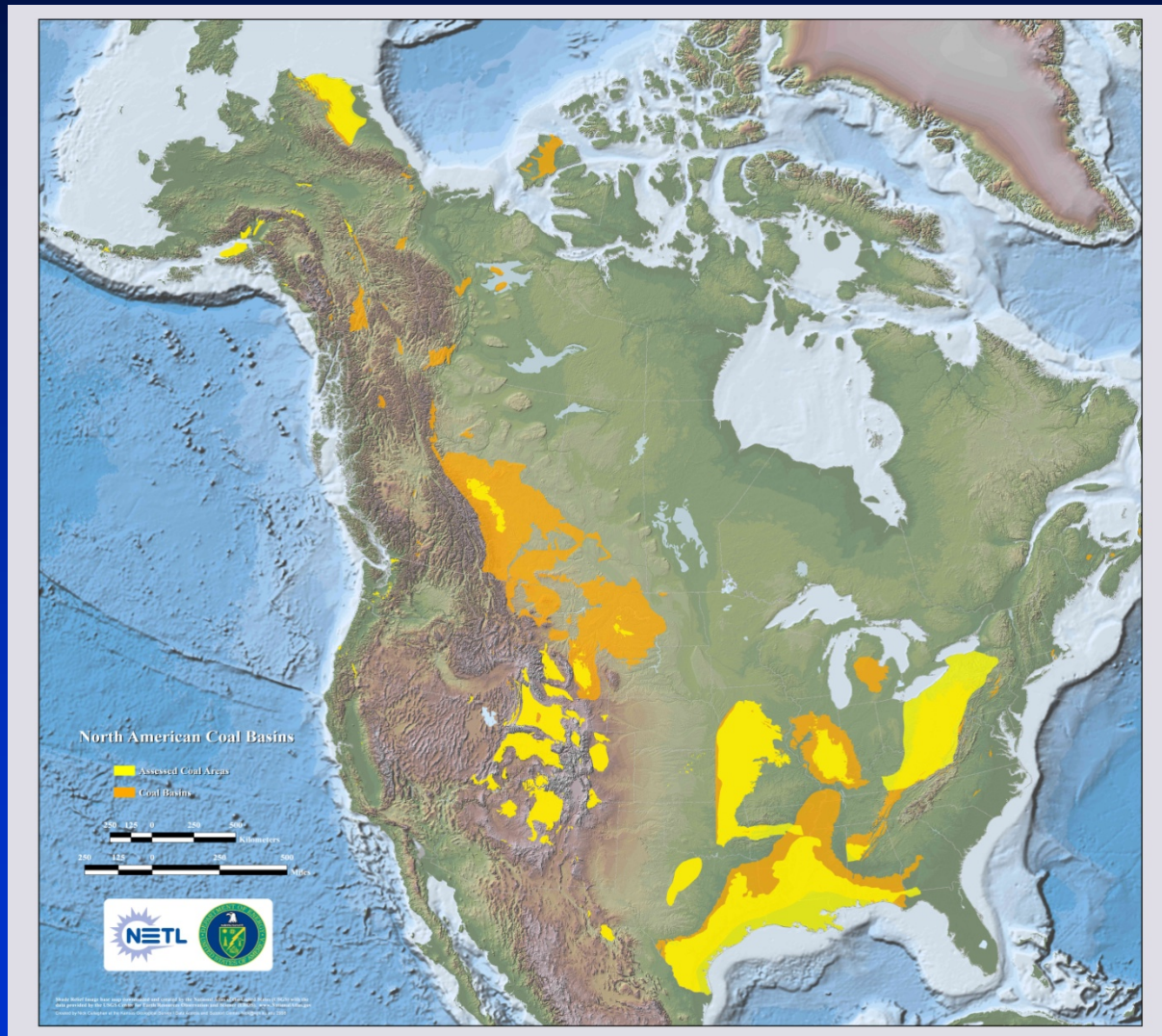
National Atlas- Saline Sinks



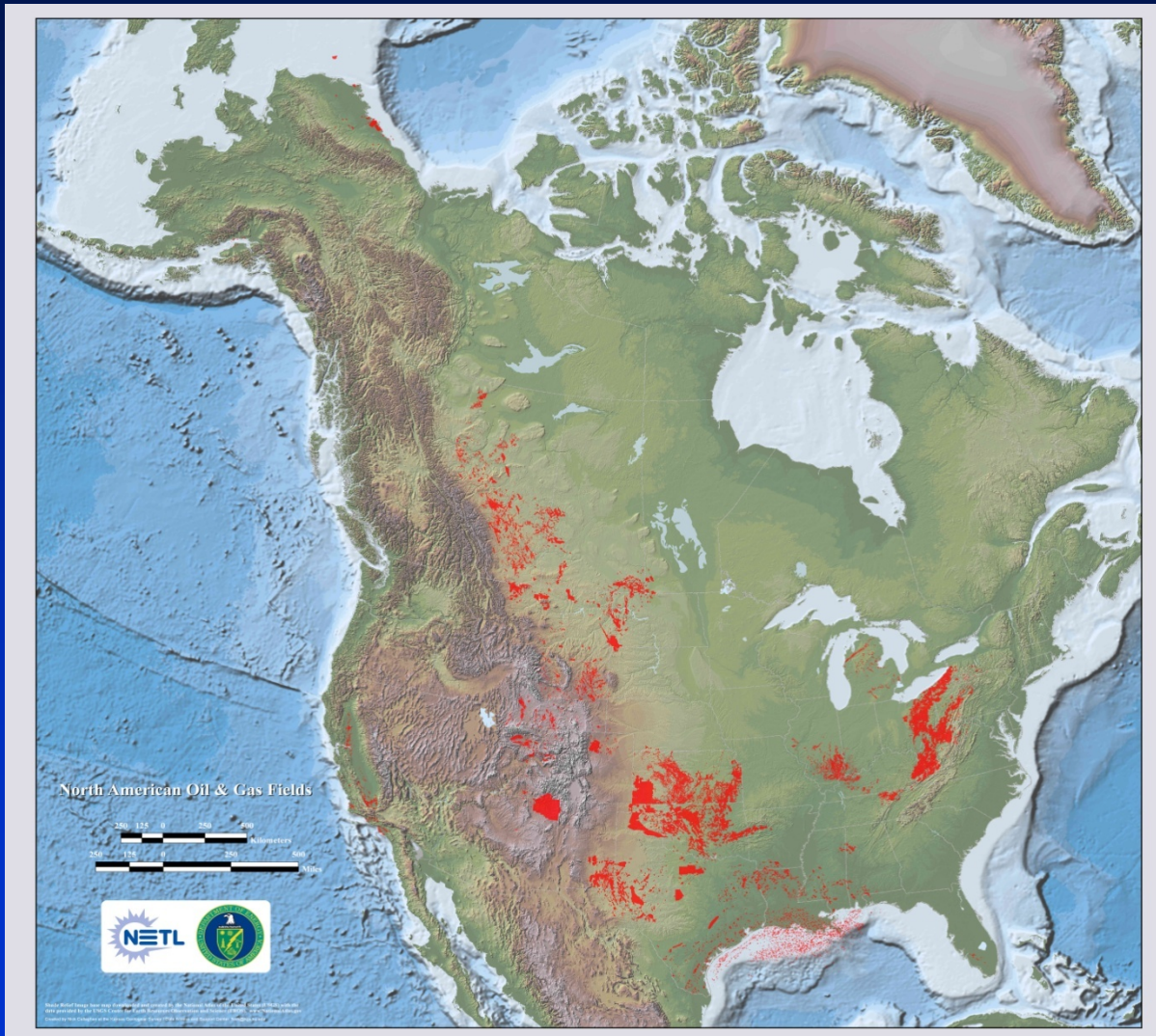
CO₂ Storage – Saline Formations

PCOOR	185	185
Illinois Basin	19.2	116.6
Midwest	118	118
Southeast	2275	9,098
WestCarb	205	807
Southwest	11	43
Big Sky	461	1,832
Total	3284	12,210

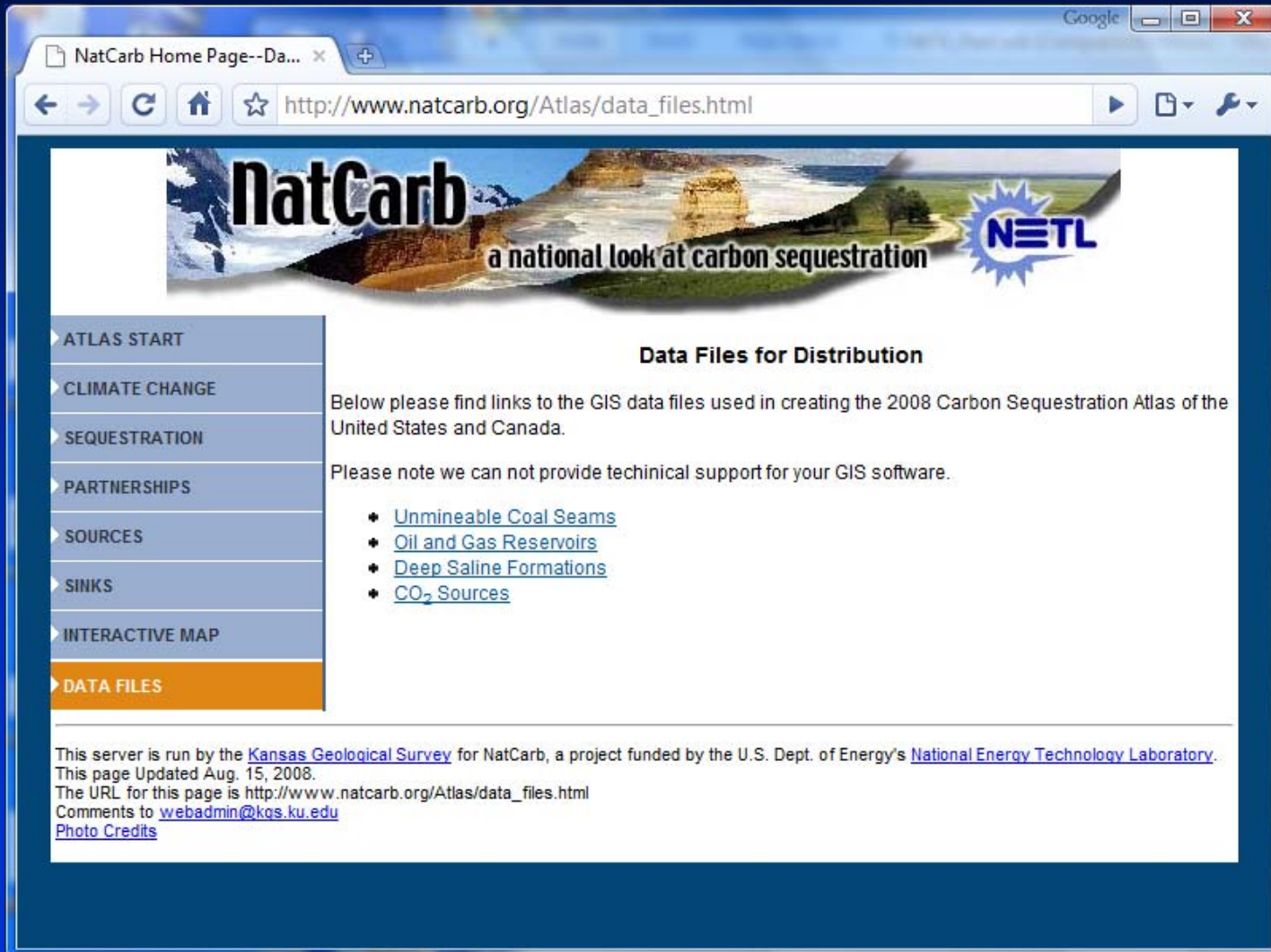
National Atlas- Coal Sinks



National Atlas- O & G Sinks



NatCarb Data Files



The screenshot shows a web browser window with the following content:

- Browser Tab:** NatCarb Home Page--Da...
- Address Bar:** http://www.natcarb.org/Atlas/data_files.html
- Header:** NatCarb a national look at carbon sequestration. Includes the NETL logo.
- Navigation Menu (Left):**
 - ATLAS START
 - CLIMATE CHANGE
 - SEQUESTRATION
 - PARTNERSHIPS
 - SOURCES
 - SINKS
 - INTERACTIVE MAP
 - DATA FILES** (highlighted)
- Main Content:**
 - Data Files for Distribution**
 - Below please find links to the GIS data files used in creating the 2008 Carbon Sequestration Atlas of the United States and Canada.
 - Please note we can not provide technical support for your GIS software.
 - Links:
 - ◆ [Unmineable Coal Seams](#)
 - ◆ [Oil and Gas Reservoirs](#)
 - ◆ [Deep Saline Formations](#)
 - ◆ [CO₂ Sources](#)
- Footer:**
 - This server is run by the [Kansas Geological Survey](#) for NatCarb, a project funded by the U.S. Dept. of Energy's [National Energy Technology Laboratory](#).
 - This page Updated Aug. 15, 2008.
 - The URL for this page is http://www.natcarb.org/Atlas/data_files.html
 - Comments to webadmin@kgs.ku.edu
 - [Photo Credits](#)

NatCarb Interactive Maps



The screenshot shows a web browser window displaying the NatCarb website. The browser's address bar shows the URL http://www.natcarb.org/Atlas/ims_map.html. The website header features the NatCarb logo and the tagline "a national look at carbon sequestration" alongside the NETL logo. A navigation menu on the left lists various sections, with "INTERACTIVE MAP" highlighted in orange. The main content area is titled "Mapping CO₂ Sources and Sinks" and contains text about the project's interactive mapping systems, a list of two maps, and a list of topics for exploration.

NatCarb
a national look at carbon sequestration
NETL

▶ ATLAS START
▶ CLIMATE CHANGE
▶ SEQUESTRATION
▶ PARTNERSHIPS
▶ SOURCES
▶ SINKS
▶ **INTERACTIVE MAP**
▶ DATA FILES

Mapping CO₂ Sources and Sinks

In addition to contributing national maps to the [Carbon Sequestration Atlas of the United States and Canada](#), the NatCarb project has created several interactive mapping systems.

The 2008 Atlas features a mapping system built using Google Maps. These maps are much easier to use than the previous maps; they are still being refined, so feel free to [email us your suggestions and comments](#).

1. [2008 Atlas Sources Map](#)
2. [2008 Atlas Sinks Map](#)

For exploring North America's CO₂ sources and sequestration opportunities, the [online atlas pages](#) have online mapping systems focussed on specific topics. These maps, on topics such as

- ◆ [Stationary Emission Sources](#),
- ◆ [Electric Power Utilities](#),
- ◆ [Oil and Gas Fields](#),
- ◆ [Deep Saline Formations](#),
- ◆ and many other topics

are easy to use while being powerful tools to explore specific resources.

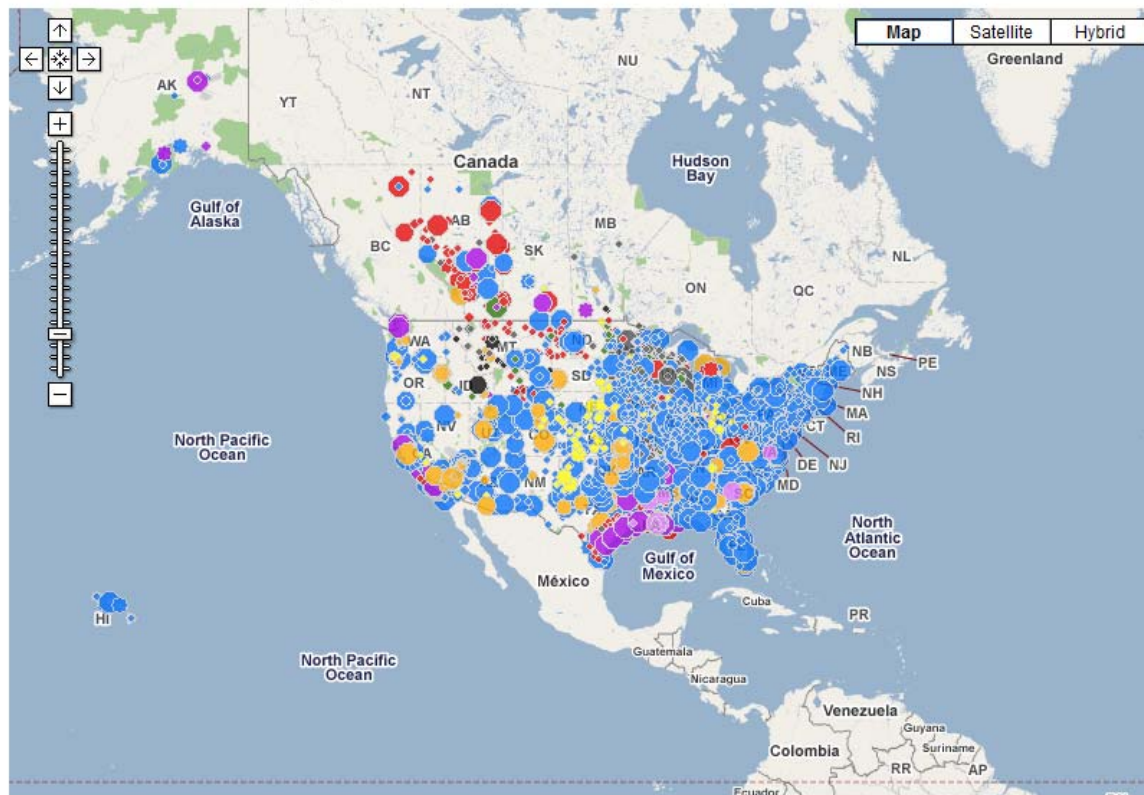
Zoom in or out, or jump to a specific state

Google Map



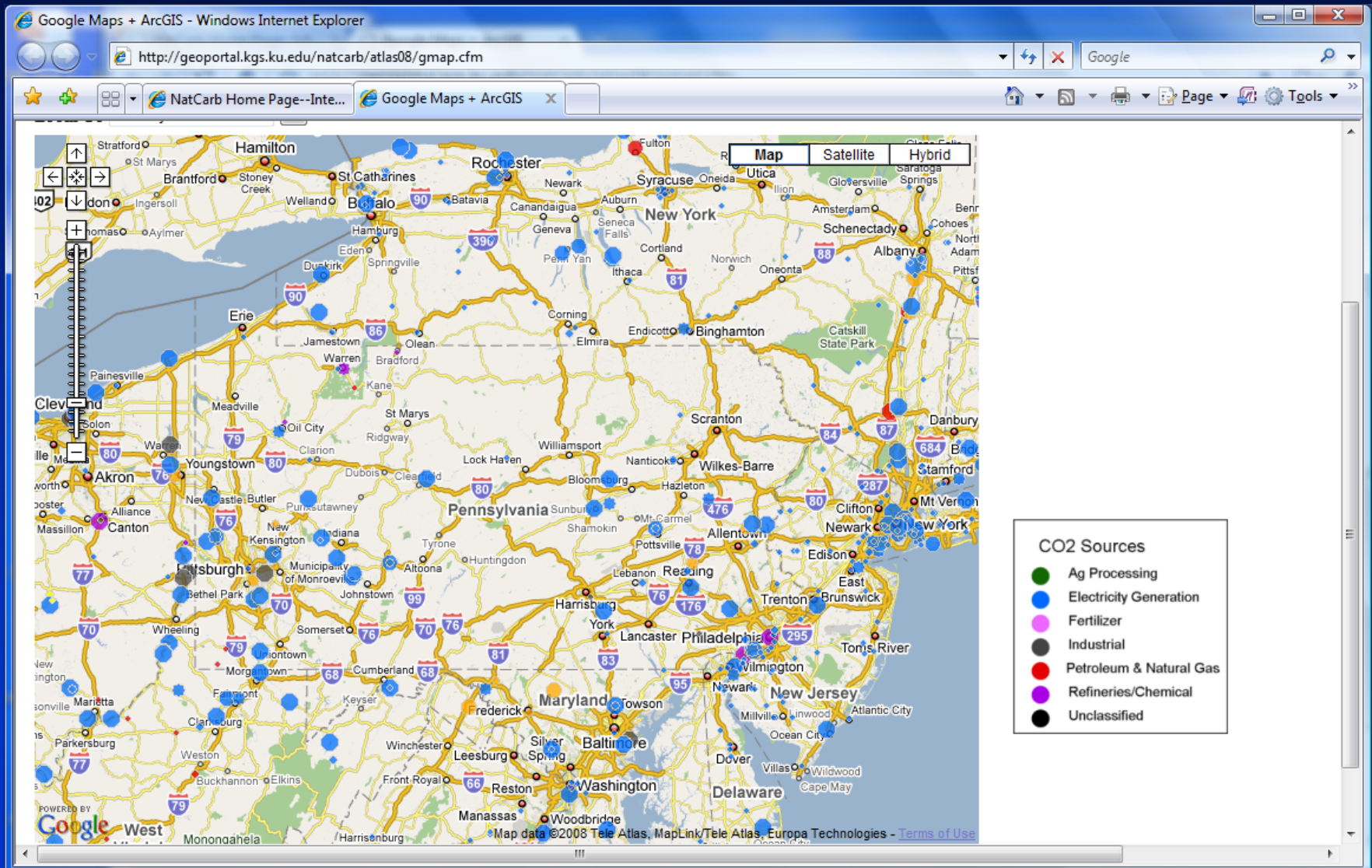
2008 Atlas - CO2 Sources

Zoom To



- CO2 Sources**
- Ag Processing
 - Electricity Generation
 - Fertilizer
 - Industrial
 - Petroleum & Natural Gas
 - Refineries/Chemical
 - Unclassified

Google Map



Google Map

Google Maps + ArcGIS - Windows Internet Explorer
http://geoportal.kgs.ku.edu/natcarb/atlas08/gmap.cfm

NatCarb Home Page--Inte... Google Maps + ArcGIS

2008 Atlas - CO2 Sources

Zoom To Ohio Go

Name: MITCHELL POWER STATION
CO2 Emissions (Metric Tonnes) : 1618950
Source Type : Electricity Generation

Map Satellite Hybrid

1 Source Found
Name : MITCHELL POWER STATION
CO2 Emissions (Metric Tonnes) : 1618950
Source Type : Electricity Generation

CO2 Sources

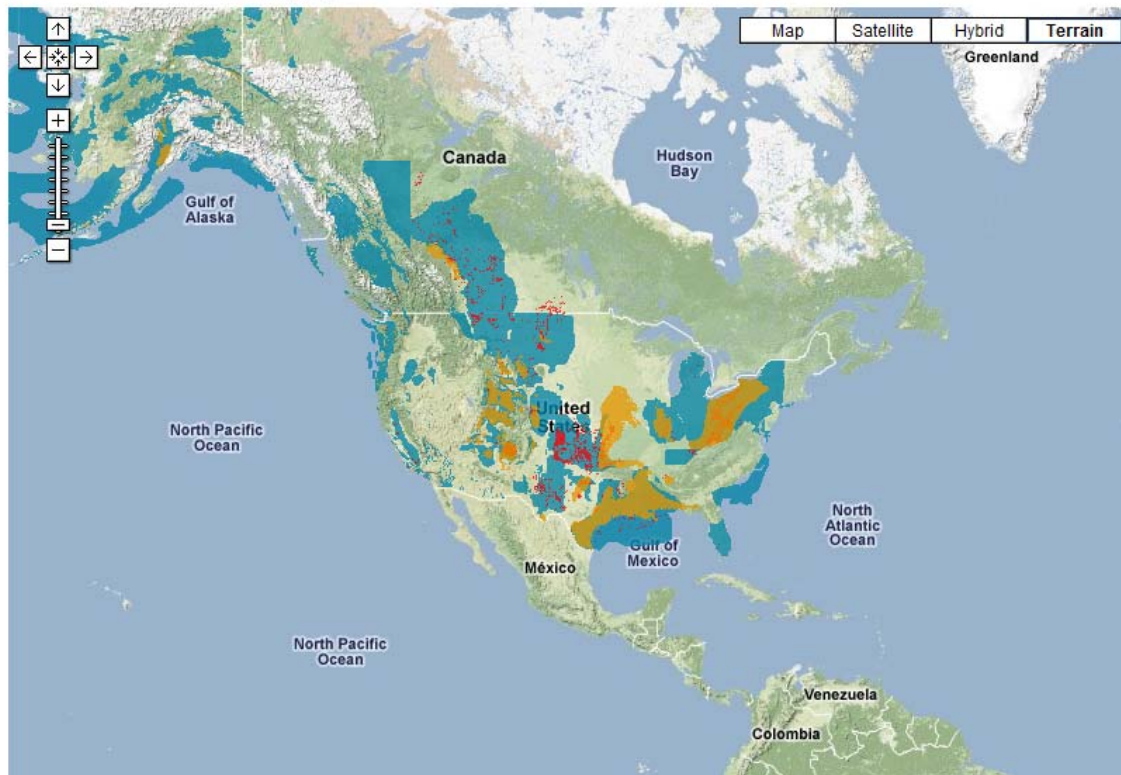
- Ag Processing
- Electricity Generation

Google Map






2008 Atlas - CO2 Sinks

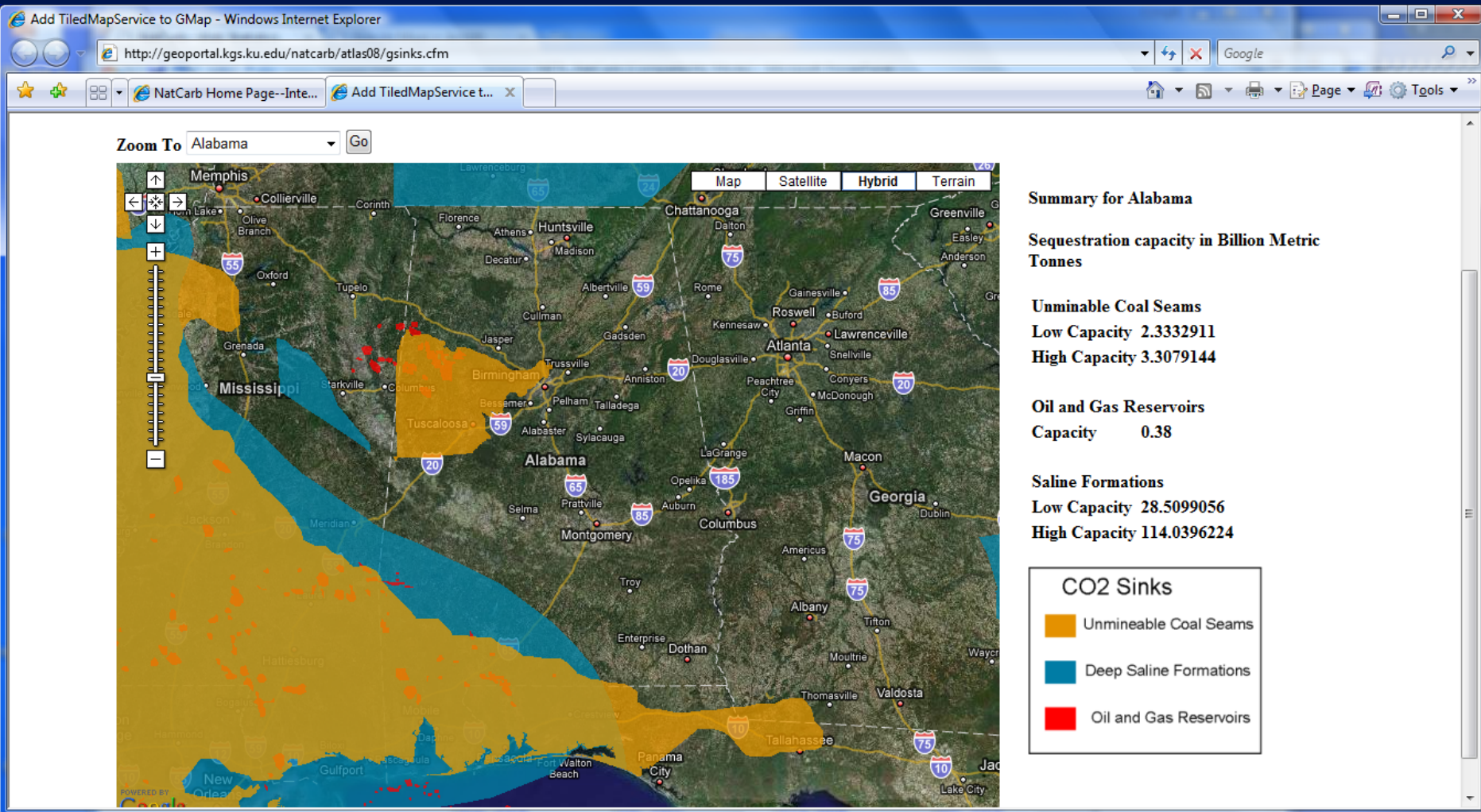
Zoom To



CO2 Sinks

-  Unmineable Coal Seams
-  Deep Saline Formations
-  Oil and Gas Reservoirs

Google Map

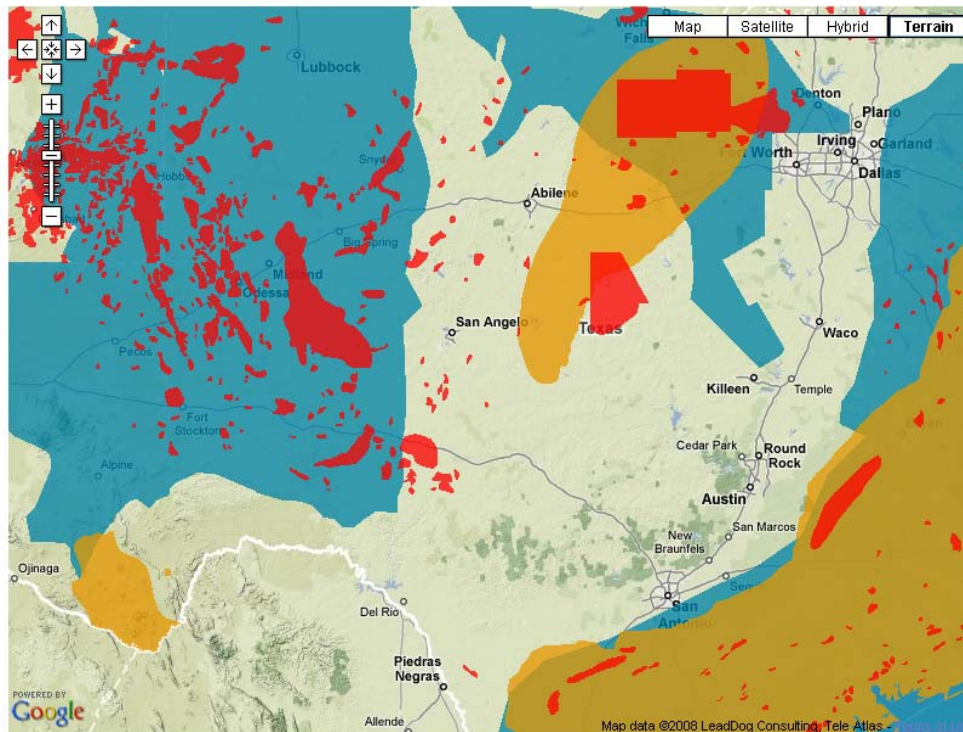


Google Map



2008 Atlas - CO2 Sinks

Zoom To



Summary for Texas

Sequestration capacity in Billion Metric Tonnes

Unmineable Coal Seams

Low Capacity 18.5381586

High Capacity 26.4689216

Oil and Gas Reservoirs

Capacity 47.1

Saline Formations

Low Capacity 535.4532656

High Capacity 2141.8130624

CO2 Sinks

Unmineable Coal Seams

Deep Saline Formations

Oil and Gas Reservoirs

Google Earth



http://geoportal.kgs.ku.edu/natcarb/basic_view/sources.cfm

NatCarb Brine Databases - 2007

The screenshot displays the NatCarb web application interface. The main map shows the United States with a grid overlay and numerous blue dots representing brine databases. The interface includes a left-hand navigation pane with various tools and a top navigation bar with menu options.

Tools

- zoom in
- zoom out
- pan
- identify
- Full Exten
- Reset Map
- Update Map
- Gazetteer Search
- Go Back

Map

- Map
- Table of Contents
- Layer Order
- Image History
- Legend & Metadata
- Help

Overview Map

NatCarb a national look at carbon sequestration **NETL**

0 590.2mi

NatCarb Brine Databases - 2008

Tools

- zoom in
- zoom out
- pan
- identify

Full Extent

Reset Map

Update Map

Gazetteer Search

Go Back

Polygon

Seq. Buffer

Pipeline Cos


Query Feature:

Bookmark:

Print


Map

- Map
- Table of Contents
- Layer Order
- Image History
- Legend & Metadata
- Help

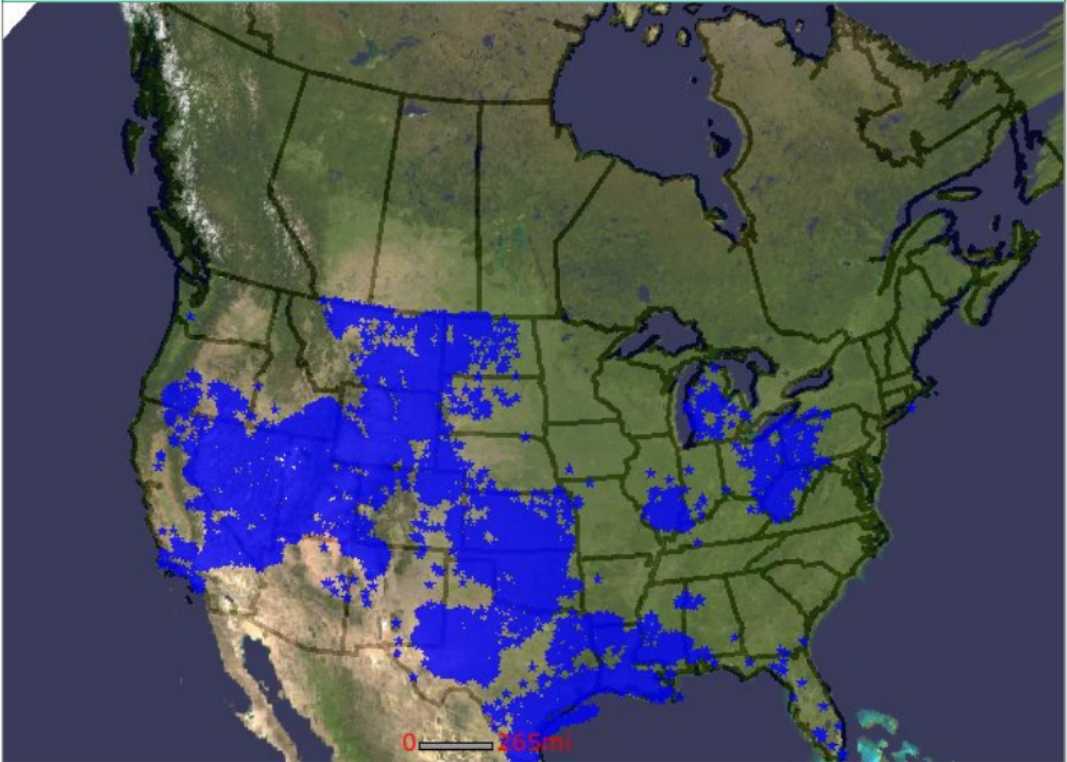


NatCarb **NETL**
a national look at carbon sequestration

Overview Map



Map



Brine Tools

Brine Data Selected - Mozilla Firefox

File Edit View History Bookmarks Yahoo! Tools Help

NatCarb Home Page natcarb_alpha Brine Data Selected

Brine Data Selected

Location Info	
State: New York	
County: CATTARAUGUS	Location: TS, R, Sec.
Formation: Oriskany	Depth: 4089
Data Source: USGS 31000010	Sample Date: Oct-19-1964

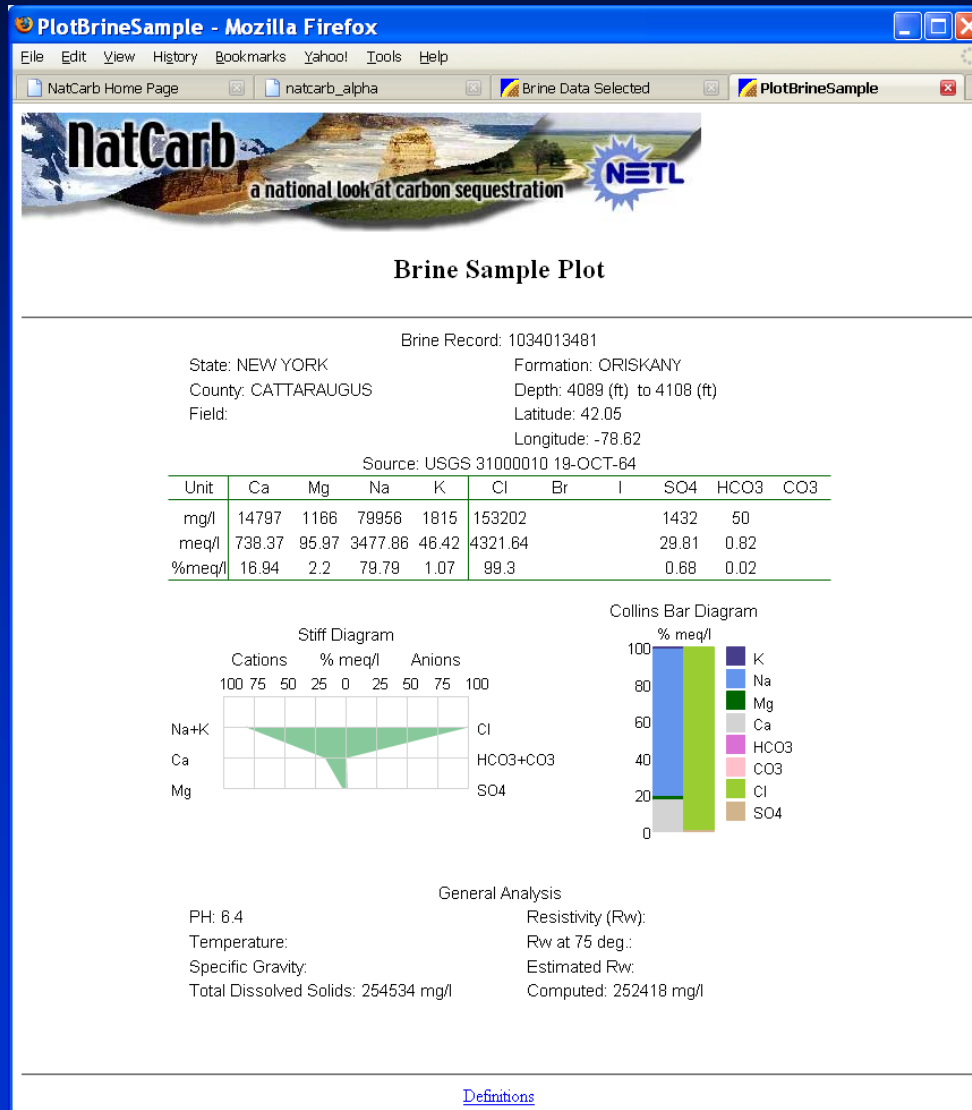
[Create Brine Sample Plot](#)
[Create Brine Data Piper Diagram](#)
Plots are presented in a new window, requires Flash.

General Analyses	
PH: 6.4	Temperature: °F
Specific Gravity:	Resistivity (Rw):
Rw at 75 deg.:	Estimated Rw at 75 deg:
Total Dissolved Solids: 254534 mg/L	

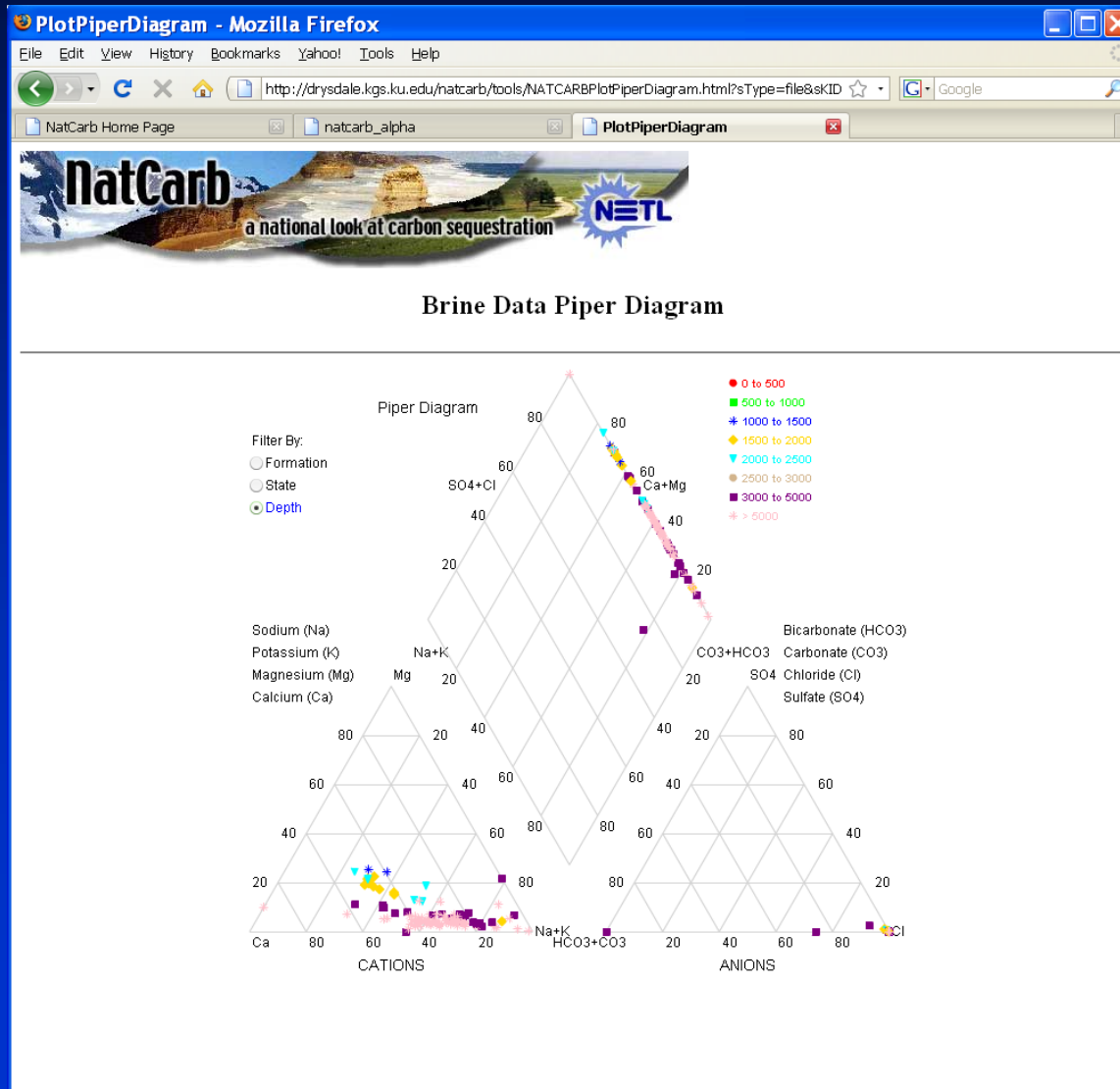
Individual Chemical Analyses	
Sodium/Potassium: NA mg/L	Sodium: 79956 mg/L
Calcium: 14797 mg/L	Magnesium: 1166 mg/L
Iron: mg/L	Chloride: 153202 mg/L
Sulfate: 1432 mg/L	Bicarbonate: 50 mg/L
Carbonate: mg/L	Bromine: mg/L
Iodine: mg/L	Hydrogen Sulfide: mg/L

This server is run by the [Kansas Geological Survey](#) for NatCarb, a project funded by the U.S. Dept. of Energy's [National Energy Technology Laboratory](#).
Programs Updated Nov. 11, 2004 The URL for this page is <http://www.natcarb.org/Group/index.html>
Comments to webadmin@kgs.ku.edu

Brine Tools



Brine Tools



Brine Analysis of Appalachian Basin

Total Dissolved Solids of Oriskany brine

Depth to Oriskany

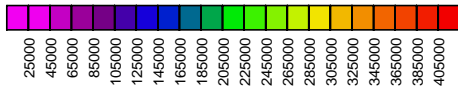


POSTED WELL DATA

●
Well Label
WELL - TDS[LITERATU]

CONTOURS

Oriskany - Total Dissolved Solids
Oriskany_TDS.GRD
Contour Interval = 5000

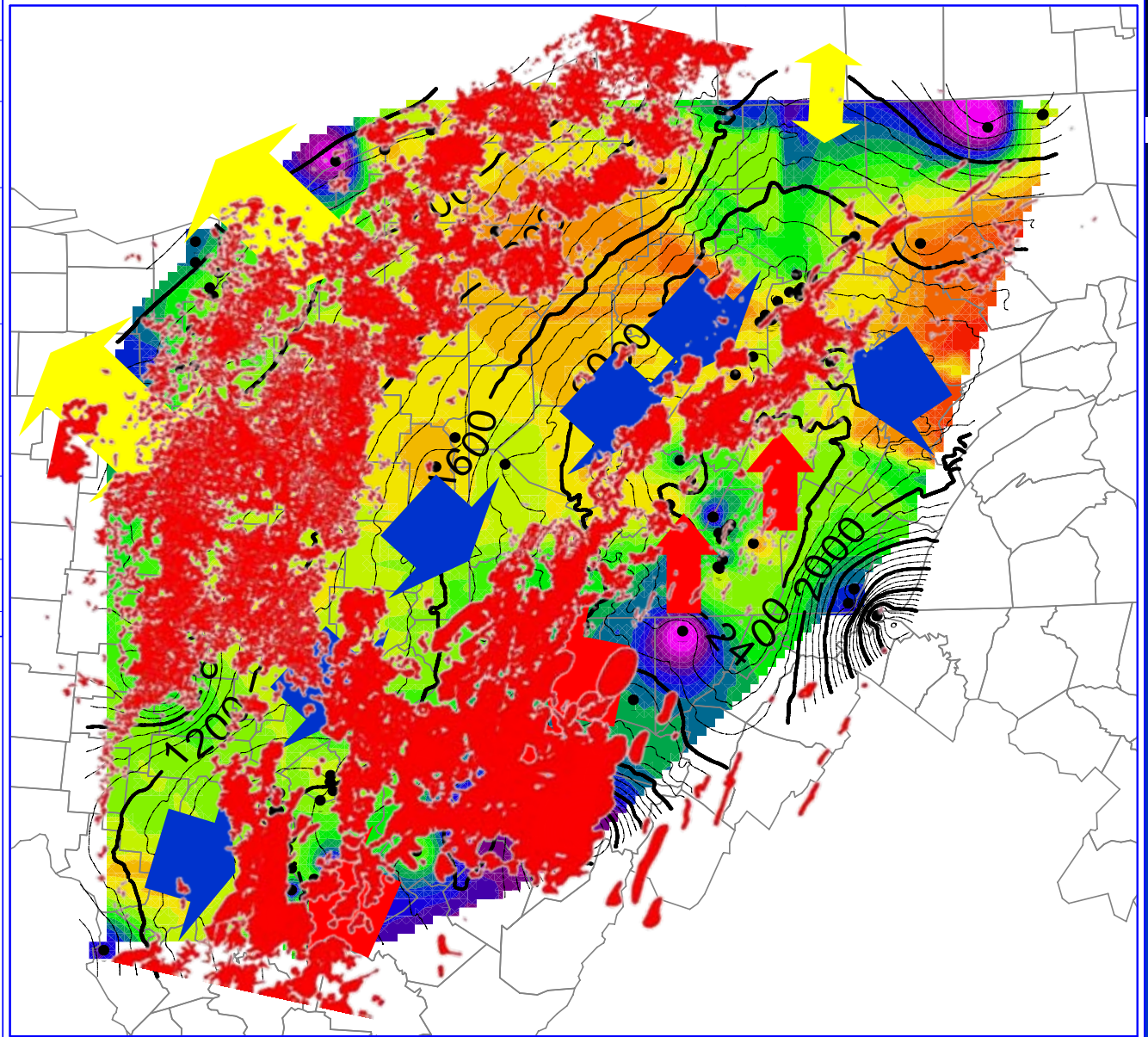


CONTOURS

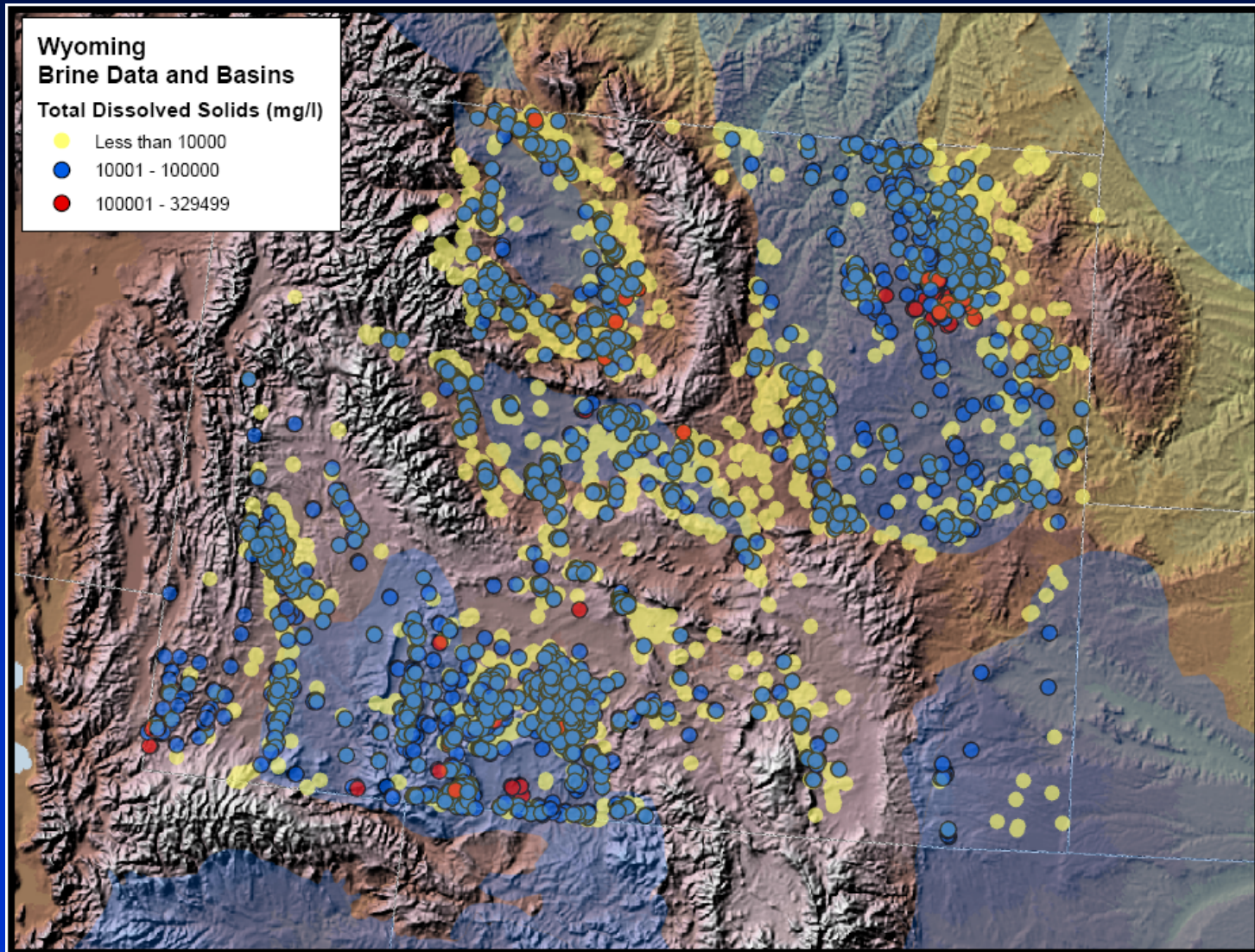
FMTOPS - ORISKANY_SANDSTONE - ORISKANY_SANDSTONE
FMTOPSORISKANY_SANDSTONE.GRD
Contour Interval = 100

●
WELL SYMBOLS
BRINE

September 14, 2008



Custom Maps



NatCarb Management

The image shows three overlapping browser windows from the NatCarb Management application:

- Top Window (Netscape):** Titled "Add Server Page - Netscape". It displays the "NATCARB" logo and three buttons: "Add Server", "Add Layer", and "Add Column". Below these is a form with fields for "Server Name" and "Port", and a "submit" button.
- Middle Window (Microsoft Internet Explorer):** Titled "Add Server Page - Microsoft Internet Explorer". It displays "MIDCARB Mapse" and three buttons: "Add Server", "Add Layer", and "Add Column". Below is a form with "Server Name" and "Port" fields and a "submit" button. A message reads: "Please Enter name and port".
- Bottom Window (Microsoft Internet Explorer):** Titled "Add Server Page Step 2 - Microsoft Internet Explorer". It displays "MIDCARB Mapservice data entry" and six buttons: "Add Server", "Add Layer", "Add Column", "View Server", "View Layer", and "View Column". Below is a form with the following fields:
 - Server Name:
 - Service Name:
 - Mapservice Name:
 - Region:
 - States Served: (with "Illinois" selected)
 - Can Portal access Map Server?: Yes No
 - Contact Person:
 - Contact Number:
 - Contact Email:
 - Username for contact person:A "submit" button is at the bottom right.

NatCarb Management

Add Server Page Step 2 - Netscape

NATCARB Mapservice data entry

Add Server Add Layer Add Column View Server View Layer View Column Add Backup Server View Backup Server

Information displayed below for
drysdale.kgs.ku.edu

Delete Server

Server Name:

Service Name:

Mapservice Name:

Region:

States Served:

Can Portal access Map Server? Yes No

Contact Person:

Contact Number:

Contact Email:

Username for contact person:

Add layer page - Netscape

NATCARB Mapservice data entry

Add Server Add Layer Add Column View Server View Layer View Column Add Backup Server View Backup Server

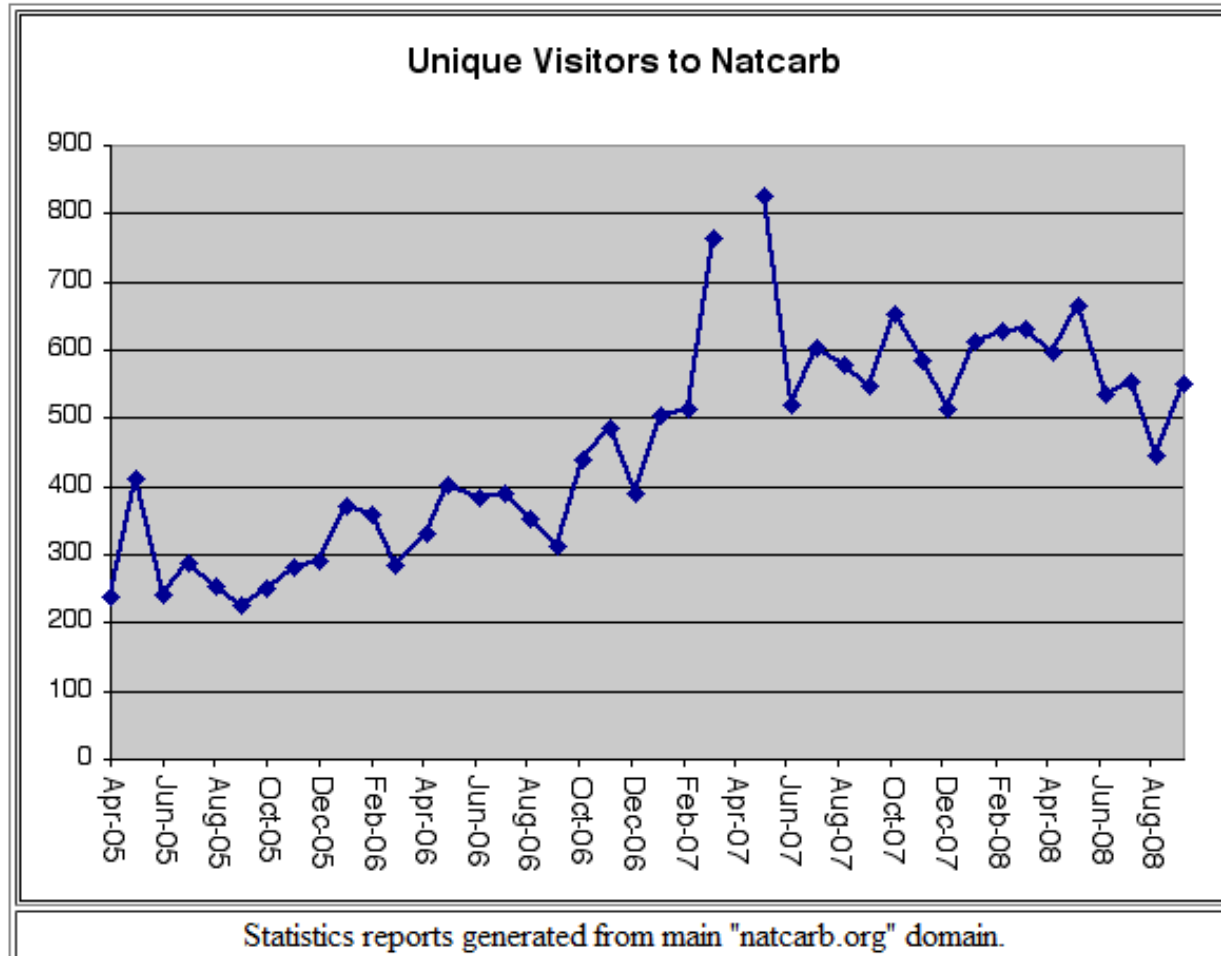
Viewing Information for layer Devonian Shale Subsurface
for kyco2 on kgsmap.uky.edu

Delete Layer

ArcIMS Layer Id	<input type="text" value="104"/>
ArcIMS Layer Name	<input type="text" value="Devonian Shale Subsu"/>
Display Name	<input type="text" value="Devonian Shale Subsu"/>
Minscale	<input type="text"/>
Maxscale	<input type="text"/>
minx	<input type="text" value="95666.1562028623"/>
maxx	<input type="text" value="1080704.64168483"/>
miny	<input type="text" value="4039081.31859062"/>
maxy	<input type="text" value="4668674.54901879"/>
Feature Type	<input type="text" value="polygon"/>
List of layer types	<input type="text" value="Petroleum"/>
Layer Group	<input type="text" value="None"/>
Is layer queryable?	<input checked="" type="radio"/> Yes <input type="radio"/> No
Layer Source (Source institution for data. For example, KGS or EPA)	<input type="text"/>
Can Layer be identified?	<input checked="" type="radio"/> Yes <input type="radio"/> No
Is Layer Visible on Viewer?	<input checked="" type="radio"/> Yes <input type="radio"/> No
Column to use for rendering	<input type="text" value="PETO.DBO.KY_DEVONIAN_SHALE_SUBSURFACE.DEVONIAN_SHALE"/>
Layer Authentication	<input type="text" value="Full access"/>
Metadata url for layer	<input type="text"/>
Detailed Metadata	<input type="text"/>

NatCarb Usage

Web Statistics



Future Near-Term NatCarb Goals

- **Improve Access for General Public**
 - **Improve Summary Layers**
 - **Simplify Navigation**
 - **Improve Quality and Coverage of National Atlas**
 - **Improved Resolution**
 - **Increase in Source and Sink Data**
 - » **Improved Sink Characterization**
 - **Improve Integration**
 - **Improve Distributed and National Databases**
 - » **Access and Coverage**
 - **Improve Analysis & Display Tools**
 - **Increased Efforts Outside United States**
- 

National Carbon Cyberinfrastructure Summary

- ◆ A **National Carbon Cyberinfrastructure** is a Significant Component of National Carbon Sequestration Efforts
- ◆ Provides Improved Access to Data and Models, Better Integration, More Effective Science and Engineering, and Enhanced Decision-Making
- ◆ **Distributed National Knowledge Base** Permits “Loose Coupling” of Elements of Carbon Science and Decision Support
- ◆ A Carbon Cyberinfrastructure:
 - * Brings Society Together with Solutions
 - * Provides Model to Manage System, Display Data, Integrate Data with Models and Manage Results
- ◆ Provides a Method to Bring the Expertise and the Data Together