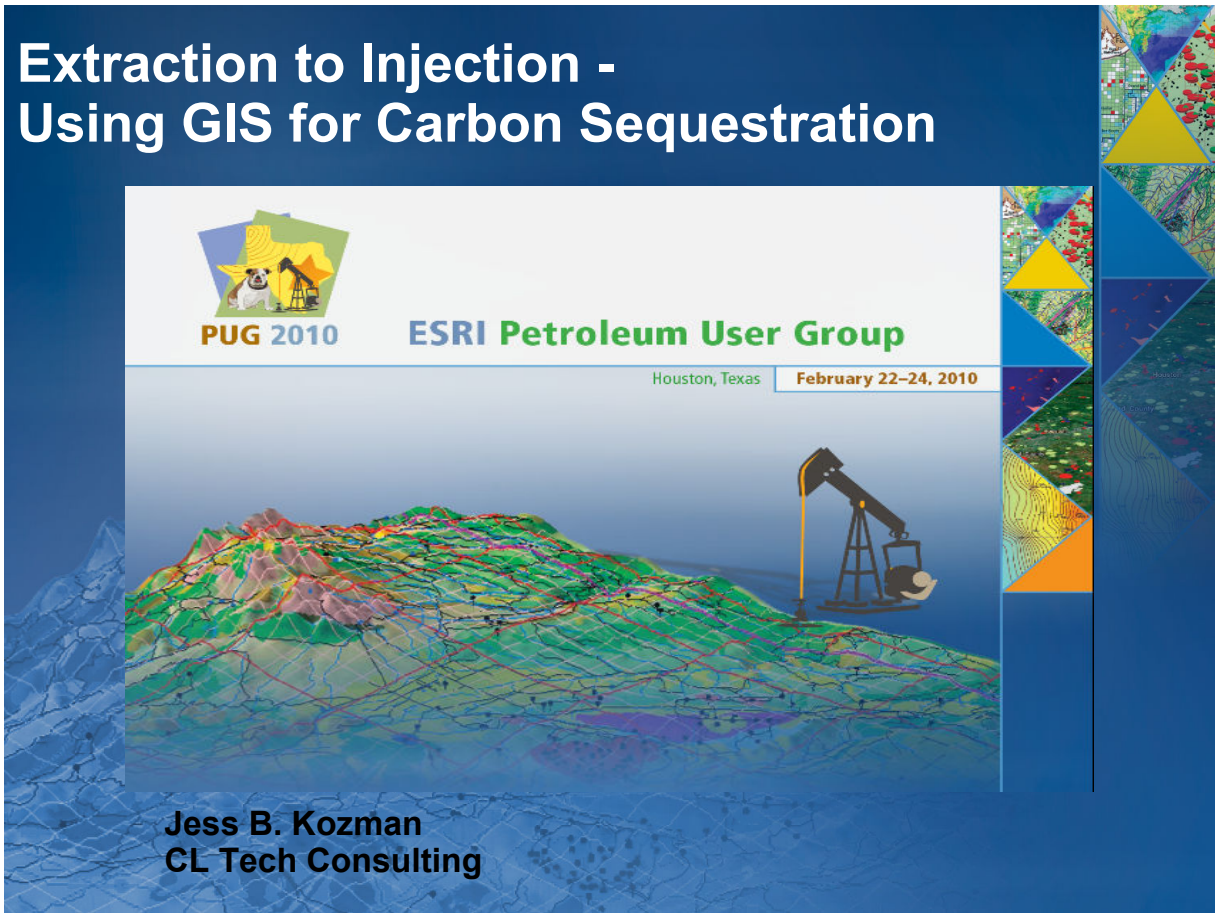
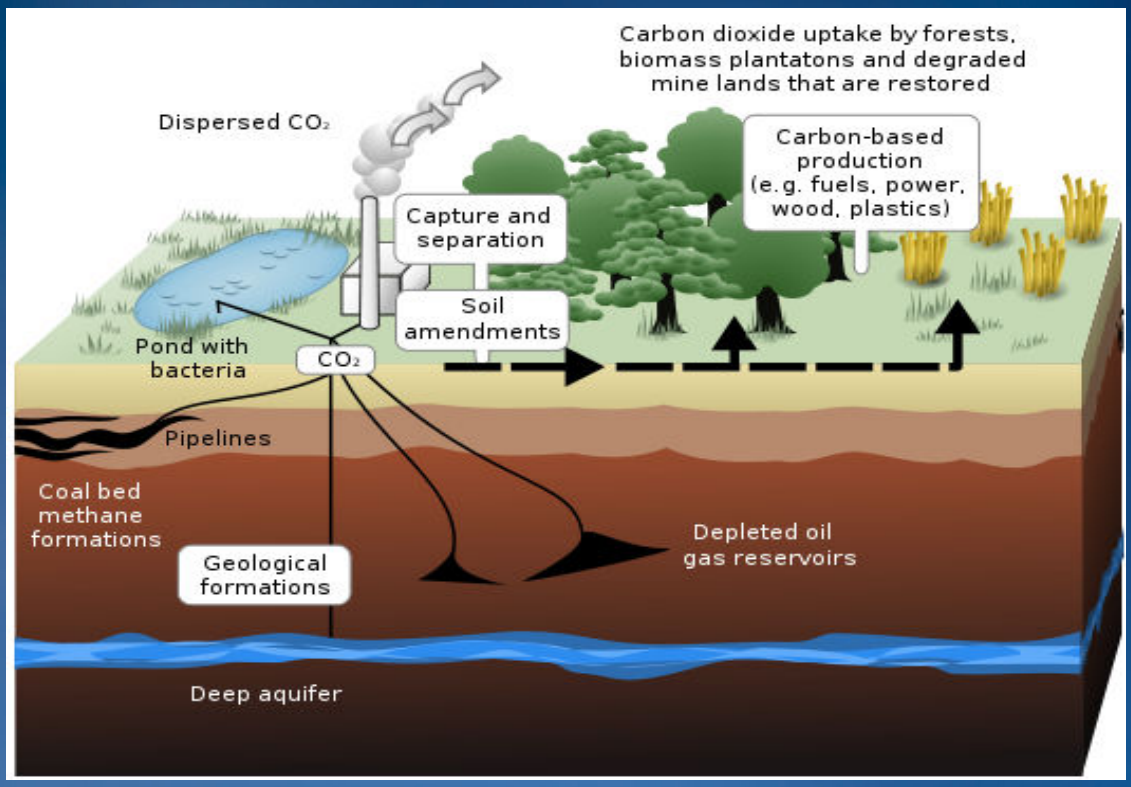
Extraction to Injection - Using GIS for Carbon Sequestration



Jess B. Kozman
CL Tech Consulting

Why the interest?



Why the interest?

1) The financial regime is coming
(Like it or not...)

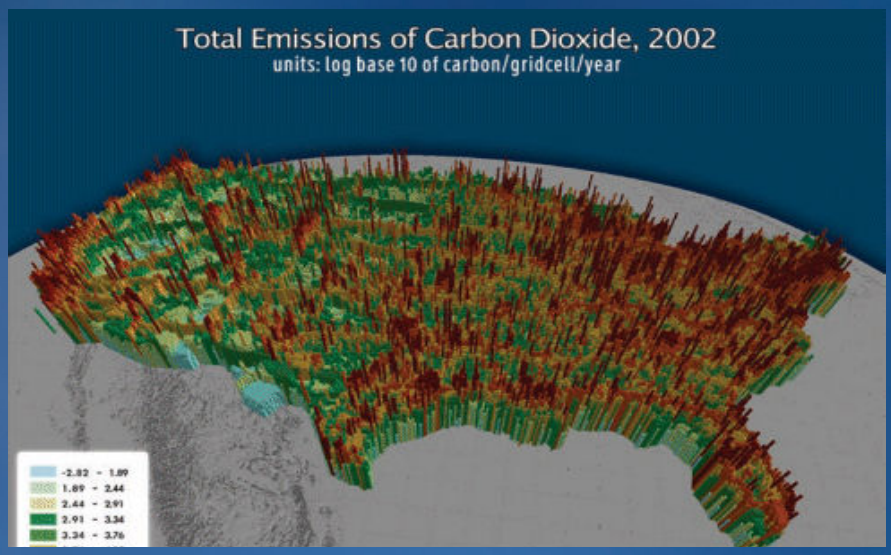
3-Feb-2010

"the largest Government investment in carbon capture and storage of any nation in history ... Interagency Task Force on Carbon Capture and Storage … 5 to 10 commercial demonstration projects online by 2016"

Norway: Sleipner West (Statoil), USD$55/ton CO2 since 1991

Why the interest?

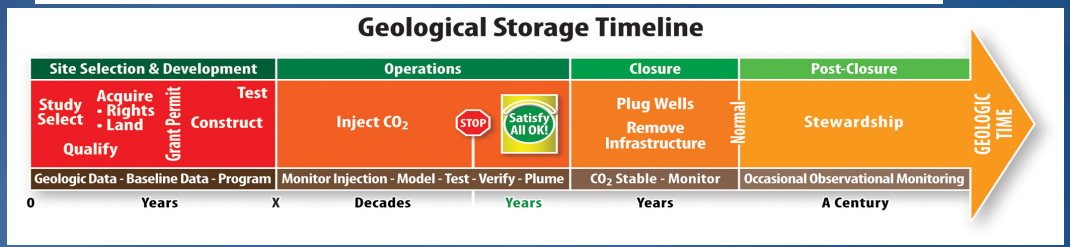
2) GIS is in the middle of it...



Why the interest?

3) Petroleum companies will be the leaders ...

bp Chevron ConocoPhillips eni PETROBRAS StatoilHydro



Public Concerns:

Identified risks and Mitigation

- **Catastrophic venting**

Field monitoring of well emissions

- **Potable aquifer contamination**

Subsurface mapping and mdeling of caprock seals

- **Induced seismicity**

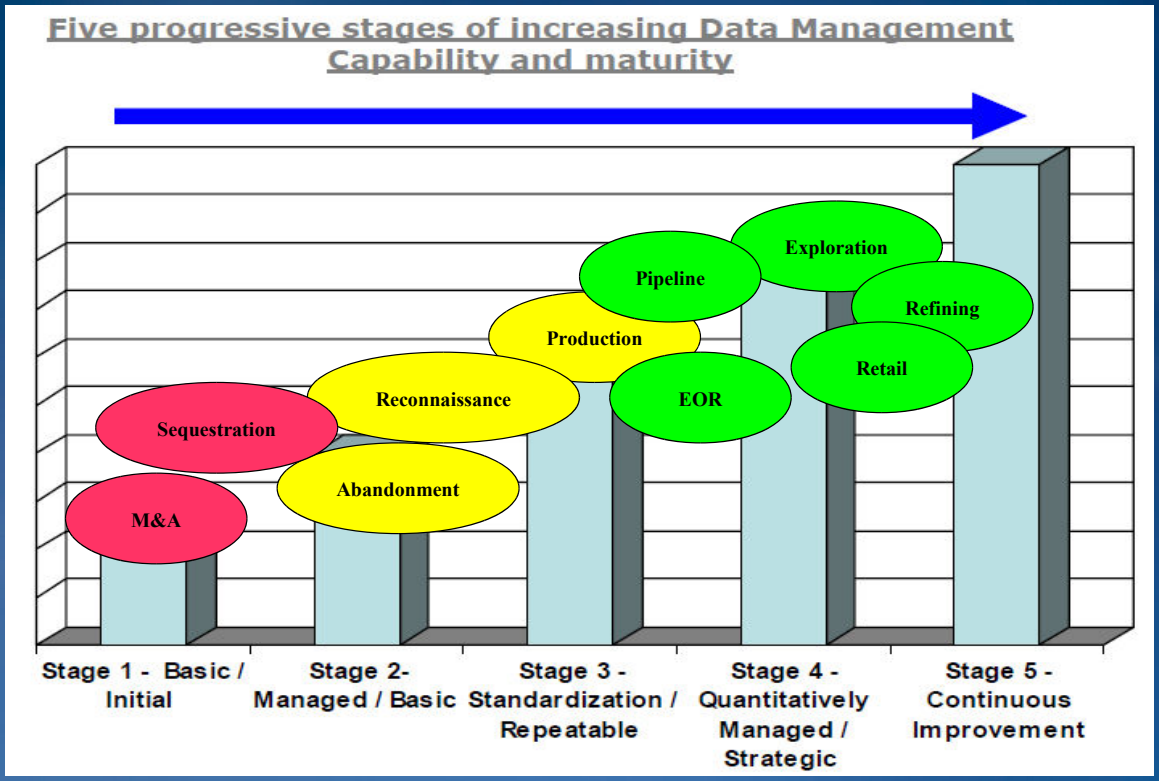
Real time microseismic interpretation

Geospatial Data Types in CO2 Sequestration

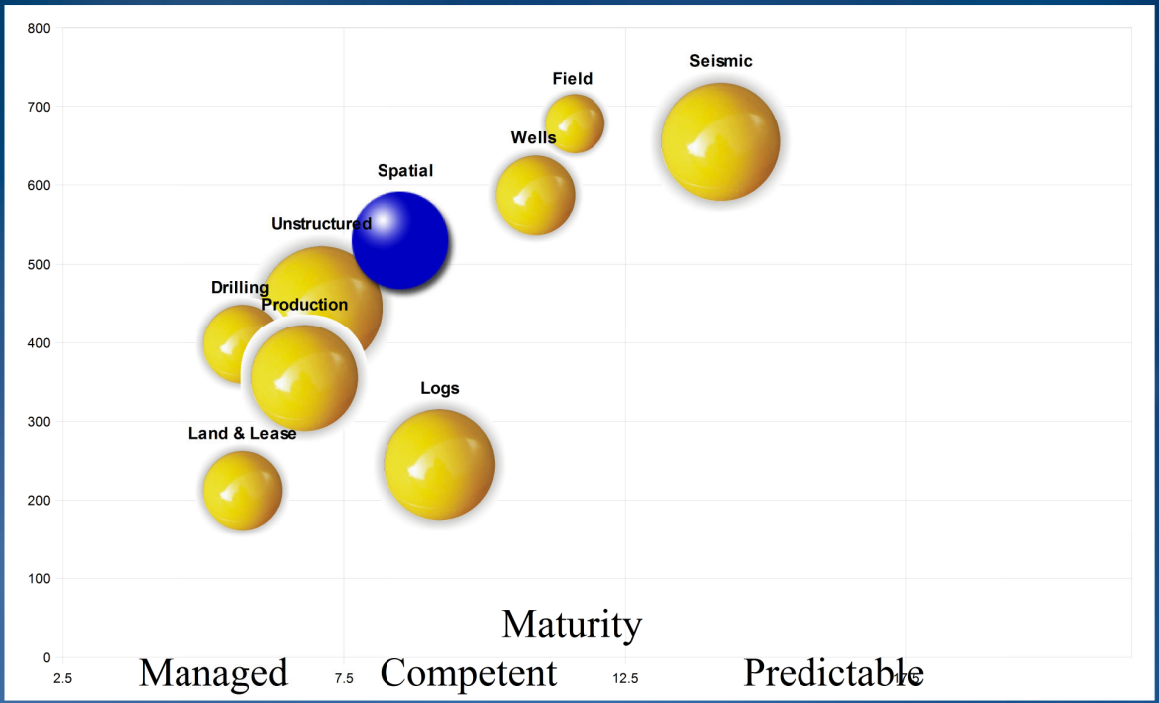
Spatial	Spatial	Culture
		Boundaries / Licenses / Leases
		License History
		Bathymetry
		Gravity & Magnetics
		Coordinate Systems
		Stratigraphic Columns
		Georeferenced Images
Seismic	Navigation	2D Navigation
		3D Navigation
		3D Outlines
	Traces	2D Seismic Trace
		3D Seismic Trace
	Other Geophysical	Acquisition Parameters
		Processing Parameters
		Velocities
Wells	Well	Headers
		Directional
	Core	Core Description
		Geochemistry
		Core Samples
	Formation	Surface Picks
		Intervals
		Pressures
Drilling	Drill/W-O	Planning
		Drilling
		Completion
		Events
		Drilling/ W-O Treatment
		Drilling/ W-O Equipment
Well Logs	Logs	Curves - Preliminary
		Curves - Final Processed
		Curves - Final Composite
		Petrophysical Parameters
		Zoned Properties
		Checkshots
		VSP
		Synthetic Seismograms
Production	Configuration	External Network
		Network
		Surface
		Sub-Surface
	Regular Data	Measured Volumes
		Other Measurements
		Operational
		Allocated Volumes
	Occasional	Planned Events
		Unplanned Events
		Samples
		Well Tests
Field	Field	Reserves
		Seismic Interpretation
		Interpretation Studies
	Model	Horizon Time Grid
		Horizon Depth Grid
		Geologic Models

85 – 90% overlap with hydrocarbon extraction data landscape

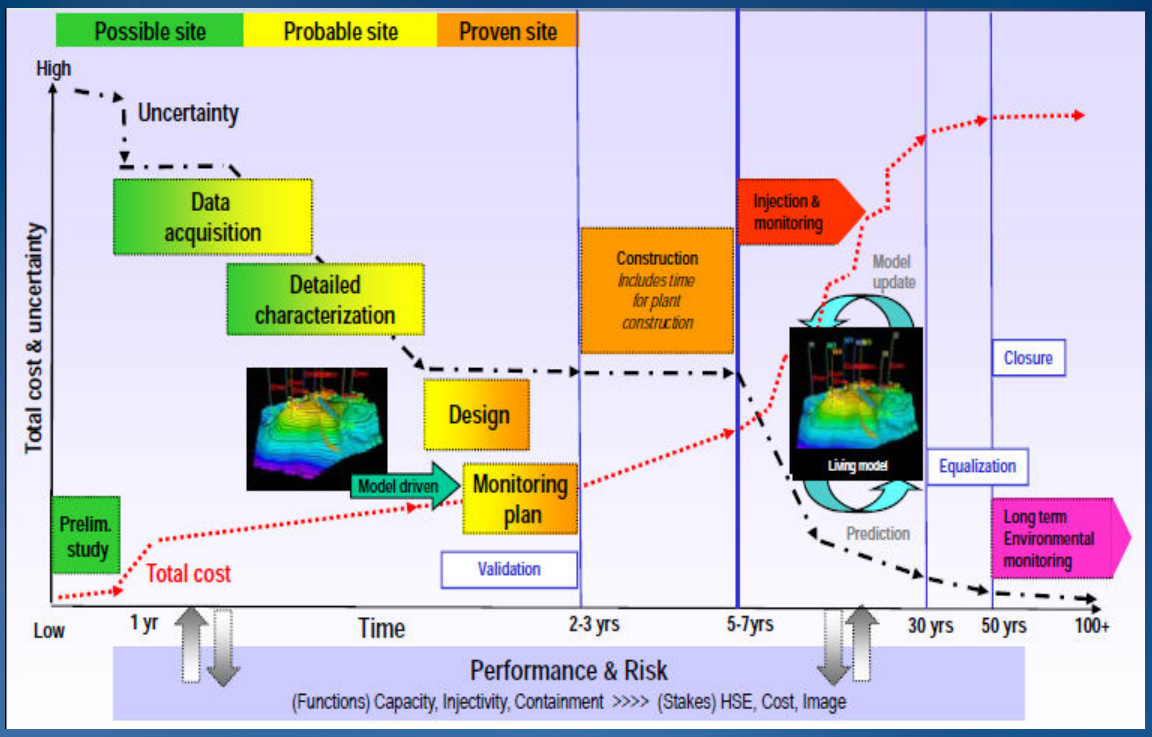
Data Management Maturity by Energy Industry Sector:



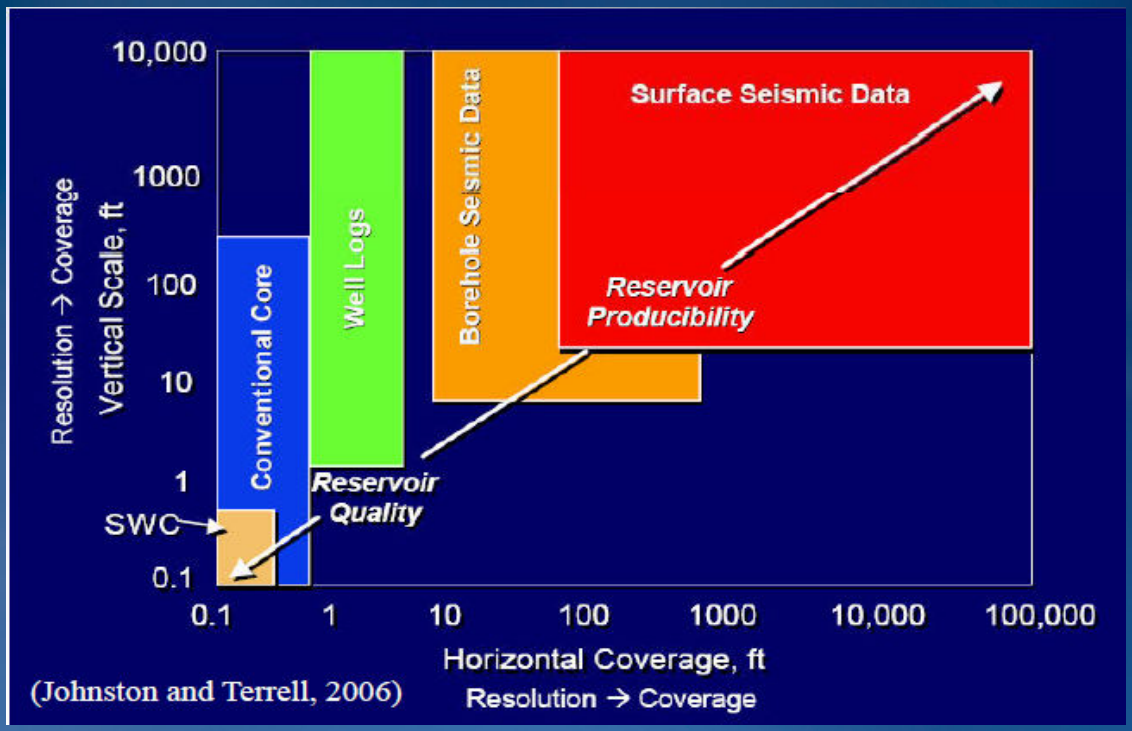
How does spatial data fit?



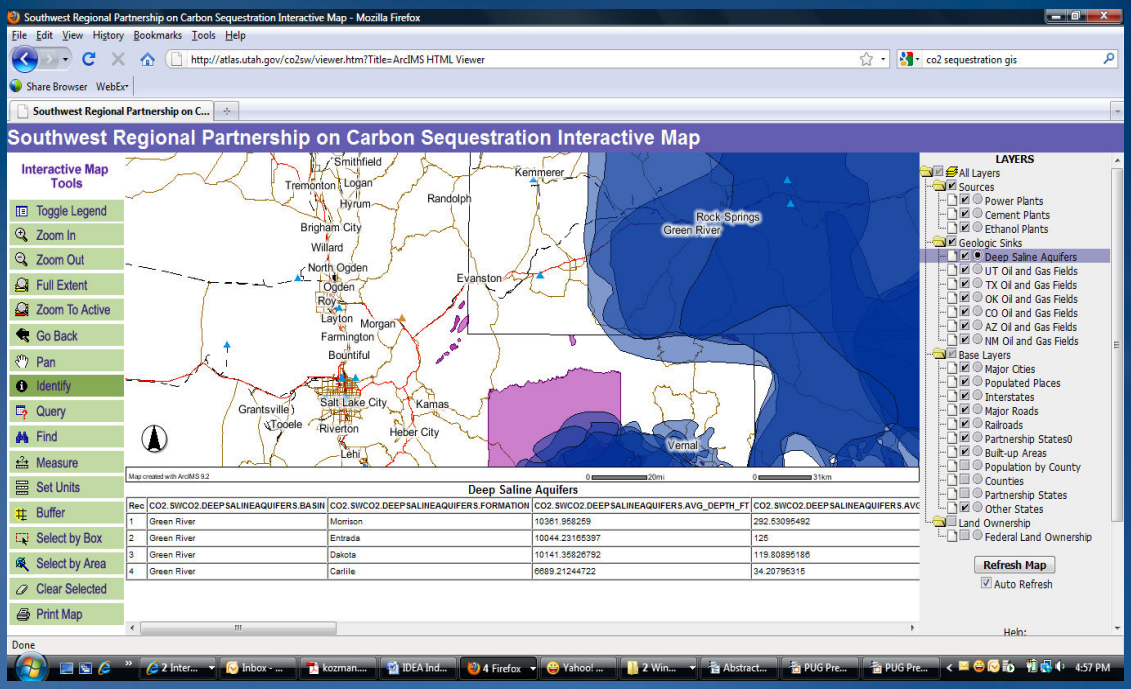
Timelines in CO2 Sequestration



Data Scales in CO2 Sequestration

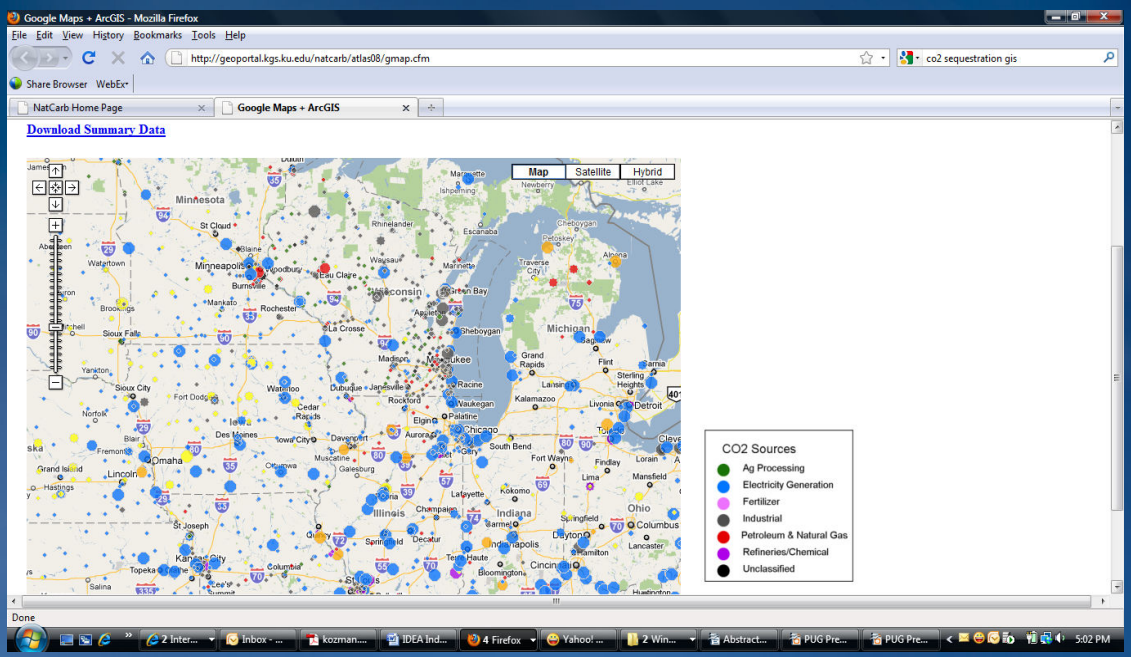


State Agency Delivery to Public Portals:

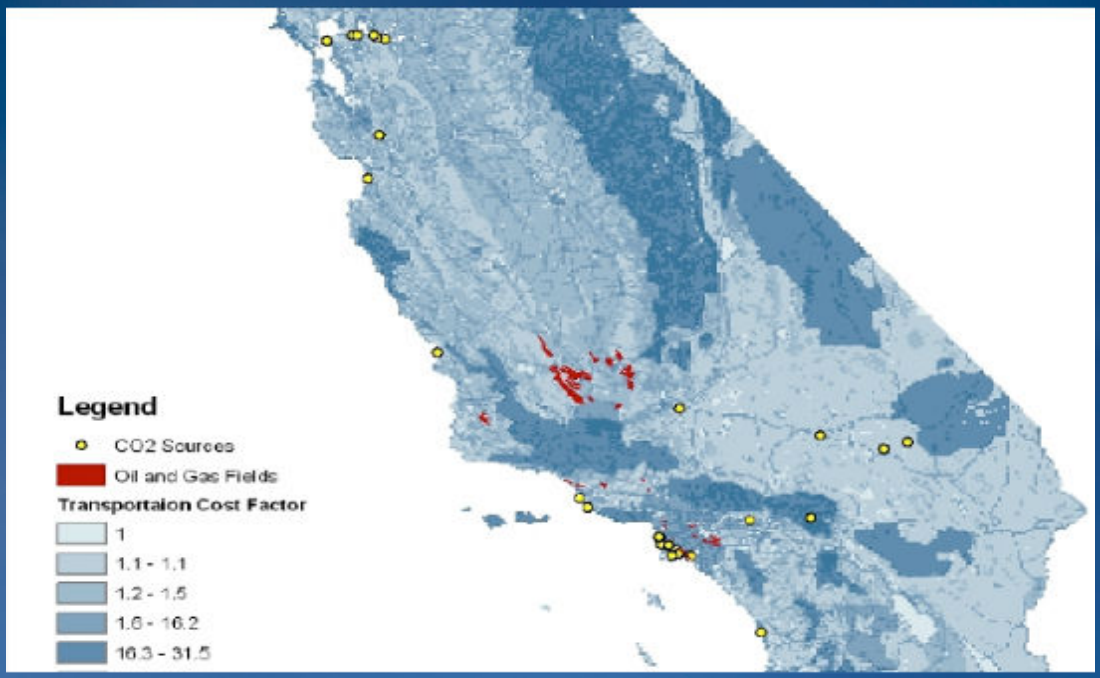


- Interactive access to information on point sources of CO2 and potential repositories

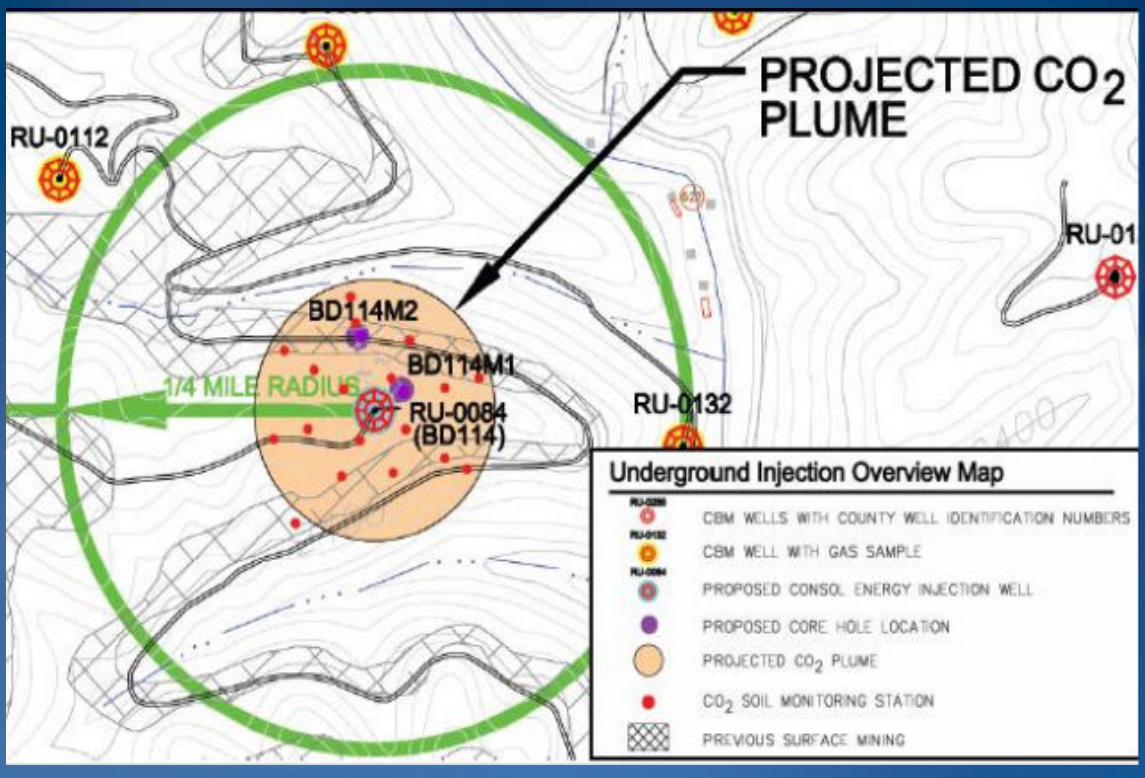
National Atlas of Point Sources:



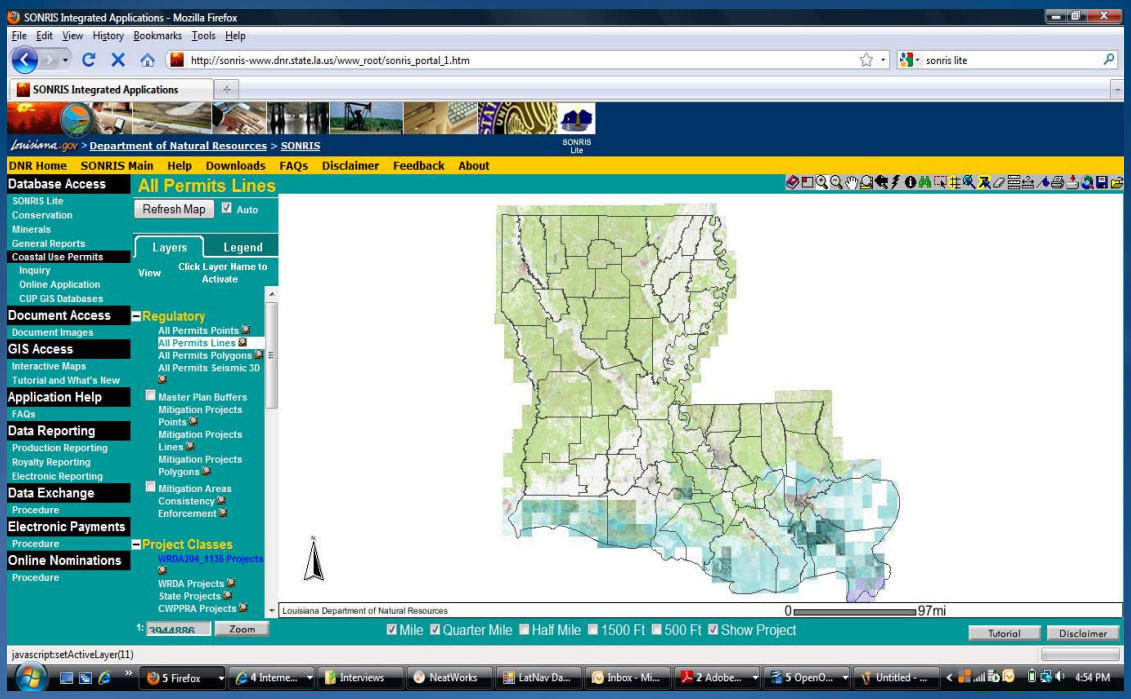
Using GIS to analyze transport costs:



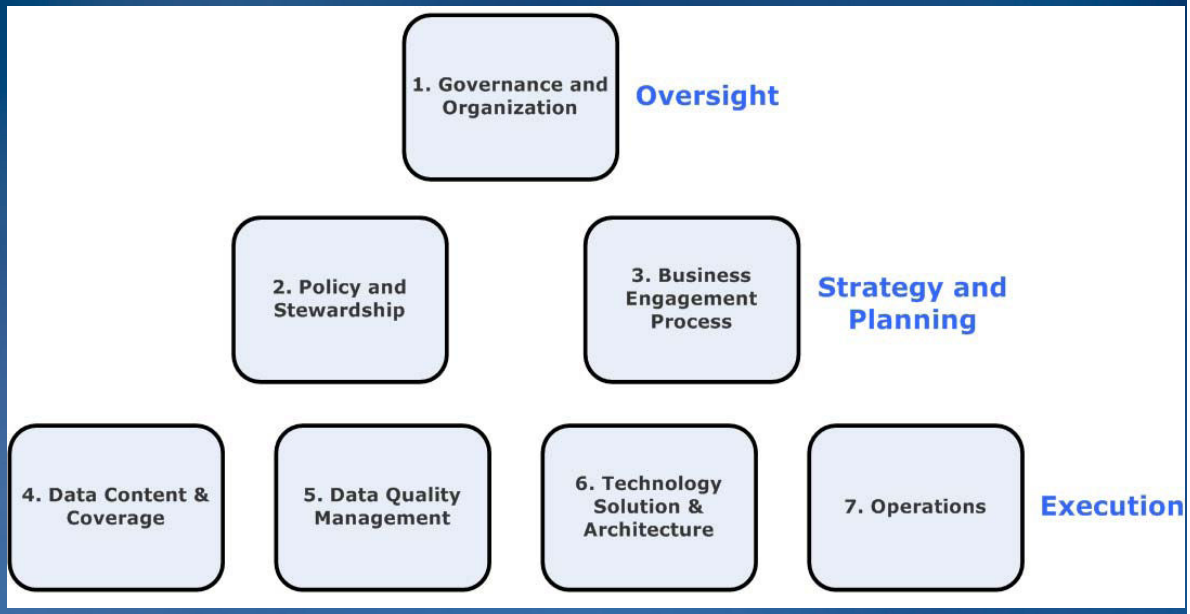
Monitoring a Plume from Injection:



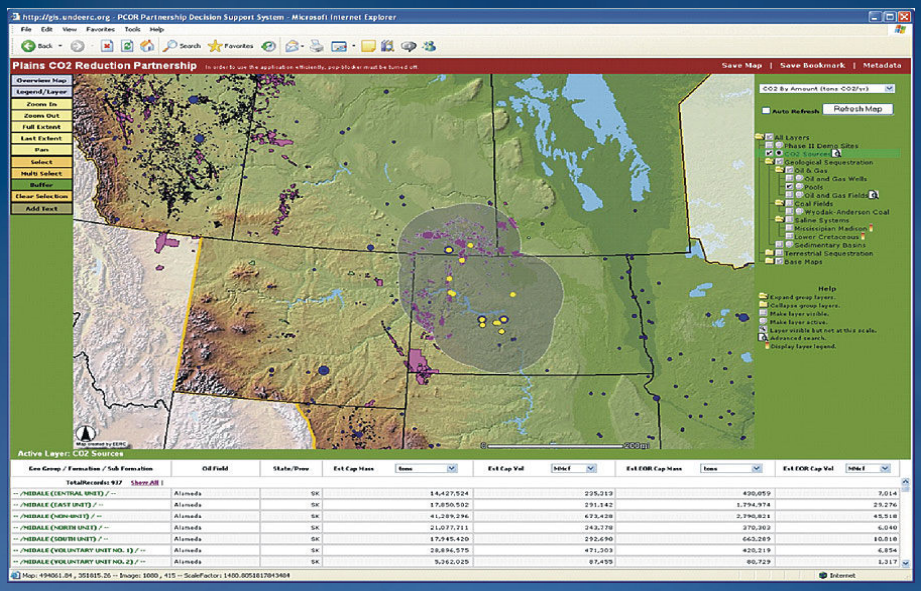
Regulation of CO2 Pipelines:



Data Management Maturity Dimensions for Spatial Data in CO2 Sequestration Projects:



Utilizing ArcGIS:



Basemap Layers
- Geology
- CO2 Point Sources

Operational Overlay
- Drilling
- Pipeline
- Injection
- Monitoring

ArcGIS 10 and CO2 Projects:

Temporal Map Services:
- CO2 Plume tracking from reservoir simulation

Statistical Simulation:
- Modeling storage capacity

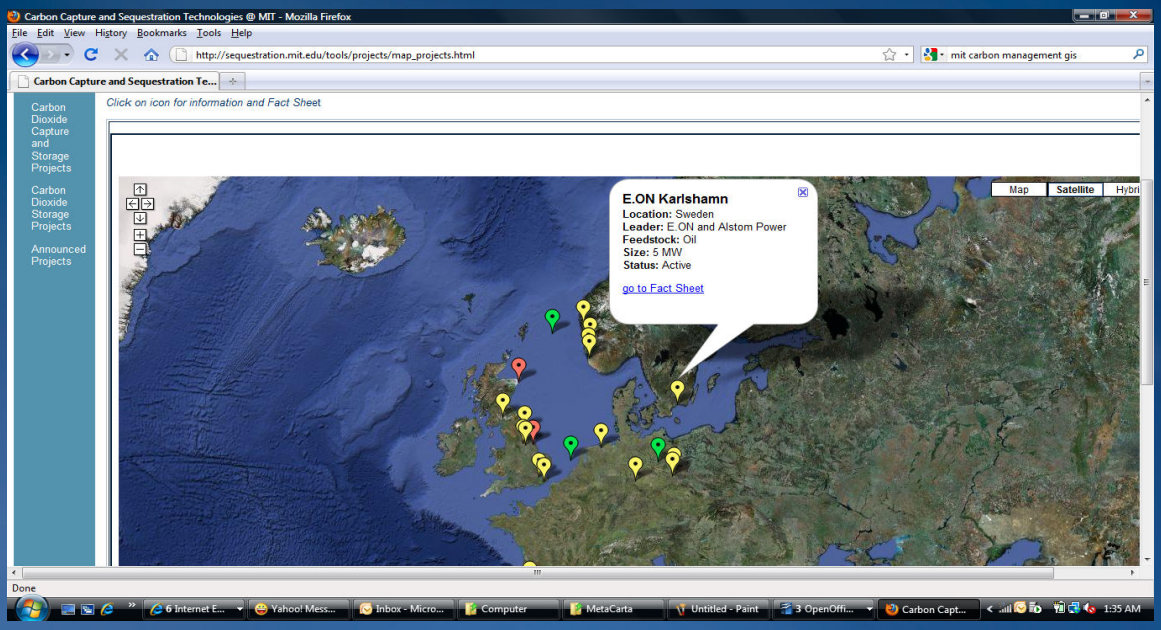
Geocoding:
- Inventory and audit of field equipment

Fuzzy Overlay and Classify:
- Visualization and communication of the site selection decision process

3D Data Management:
- Subsurface imaging and monitoring

Mobile Services:
- Spot monitoring of emissions and air quality

Show Me the Money!



MIT Carbon Atlas:
DOE Funding of USD $ 1.2 M

Credits, Acknowledgments, Sources and Attributions

Slide 3: http://en.wikipedia.org/wiki/Carbon_capture_and_storage

Slide 5: http://www.purdue.edu/eas/carbon/vulcan/plots.php

Slide 6: Managing Uncertainty in Geologic Storage, "Measure Twice Cut Once", John Tombari, Schlumberger Carbon Services

Slide 7: Categories from: Union of Concerned Scientists, POLICY CONTEXT OF GEOLOGIC CARBON SEQUESTRATION http://www.ucsusa.org/assets/documents/global_warming/geo_carbon_seq_for_web.pdf

Slide 8: The Main Sequence: Matching Data Management Change to the Organization, Kozman and Hawtin, 12th International Conference on Petroleum Data Integration, Information and Data Management, Houston, Texas, April 8-10, 2008

Slide 9: Adapted from: UNDERSTANDING AND OPTIMIZING YOUR FIRM'S DATA MANAGEMENT CAPABILITIES USING MATURITY MODELS, Lakefront Consulting Data Management White Paper, http://www.lakefrontdata.com/style/LakeFront_Consulting_EDM_Maturity_Model_Jan_2009.pdf

Slide 11: CO2 Sequestration in Saline Reservoirs, Dwight Peters, Schlumberger Carbon Services, December 4, 2008, Wyoming DEQ Meeting

Slide 12: (Johnston and Terrell, 2006), Terrell, T. Davis, L. Brown, R. Fuck, 2002. Seismic monitoring of a CO2 flood at Weyburn field: Demonstrating the robustness of time-lapse seismology. Society of Exploration Geophysics Annual Meeting, Expanded Abstracts, 16731676

Slide 13: http://gis.utah.gov/agrc-carbon-sequestration-project/doe-carbon-sequestration-partnership

Slide 14: http://geoportal.kgs.ku.edu/natcarb/atlas08/gmap.cfm

Slide 15: West Coast Regional Carbon Sequestration Partnership CO2 Sequestration GIS Analysis, Topical Report, West Coast Regional Carbon Sequestration Partnership, (WESTCARB), Principal Author: Howard J. Herzog
September 30, 2005, http://www.netl.doe.gov/technologies/carbon_seq/partnerships/phase1/pdfs/final%20westcarb%20GIS.pdf

Slide 16: GEOPHYSICAL MONITORING OF THE CO2 PLUME AT SLEIPNER, NORTH SEA, NATO Science Series, ISSN1568-1238
Volume Volume 65, Advances in the Geological Storage of Carbon Dioxide, Springer Netherlands, DOI 10.1007/1-4020-4471-2, Copyright 2006, ISBN 978-1-4020-4469-4 (Print) 978-1-4020-4471-7 (Online)

Slide 17: http://sonris-www.dnr.state.la.us/www_root/sonris_portal_1.htm

Slide 18: UNDERSTANDING AND OPTIMIZING YOUR FIRM'S DATA MANAGEMENT CAPABILITIES USING MATURITY MODELS, Lakefront Consulting Data Management White Paper

Slide 19: A Study of the Great Plains of North America, Carbon Dioxide Sequestration Communications Supported by GIS, Wesley D. Peck, research scientist, Energy & Environmental Research Center, University of North Dakota, ArcNews Winter 2006/2007 issue

Slide 21: http://sequestration.mit.edu/tools/projects/map_projects.html