Using Environmental Monitoring to Build Stakeholder Trust

Dr. Katherine Romanak
Gulf Coast Carbon Center
Bureau of Economic Geology
The University of Texas at Austin

Upscaling of CCS in Denmark - CCS Conference 2025
May 26, 2025
Rungstedgaard

The Gulf Coast Carbon Center

- For over 25 years we have been:
- Conducting studies in on geological storage, retention and monitoring of CO_2 in the deep subsurface
- Educating the public about the process of geological CO_2 storage, the risks and mitigation measures associated with carbon capture and storage deployment
- Enabling the private sector to develop a viable industry to store CO_2 in the Gulf of Mexico, across the U.S., and globally

Geologic Characterization

Carlos Uroza | Alex Bump | Timothy Meckel | Mariana Olariu

Fluid-Flow Modeling

Seyyed Hosseini | Sahar Bakhshian

Surface or Deep Monitoring

Hailun Ni | Katherine Romanak | Susan Hovorka

Economist and EJ

Ramon Gil

Communications Coordinator

Dolores van der Kolk

International Research Fellows

Tim Dixon, IEAGHG, UK | Charles Jenkins CSIRO, Australia

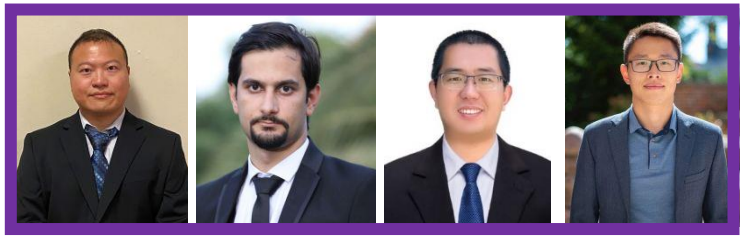
Seismic Interpretation

Michael DeAngelo | Dallas Dunlap | Tucker Hentz | Ramón Treviño

Graduate Students

Edna Rodriquez Calzado | Ismail Halim Farugi | Richard Colt Larson | Yushan Li | Angela Luciano | Maria Paula Madariaga | Chinemerem Okezie | Shadya Taleb Restrepo | Jose Eduardo Ubillus | Charlie (Yu-Chen) Zheng

Postdoctoral Fellows

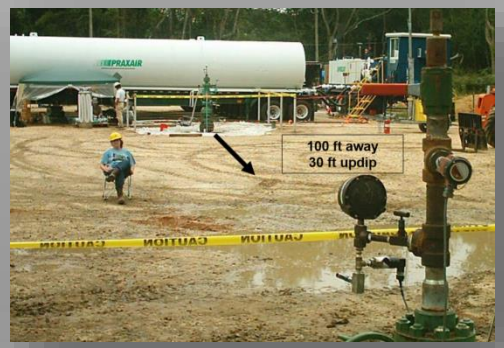


Jianqiao (Tim) | Reza | Hongsheng | Zhicheng

Evolution of GCCC Project Experience

Pilots → Demonstrations → Industrial

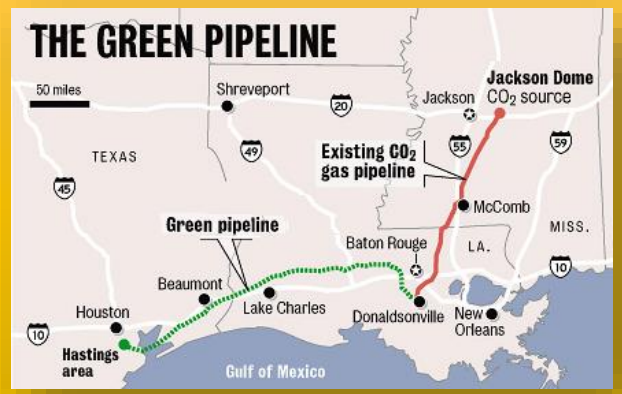
500 T



Frio Brine Storage Pilot 2004

SECARB Demonstration Project in Mississippi

Hastings Project



NRG Petranova Project

1.6 MMT/year

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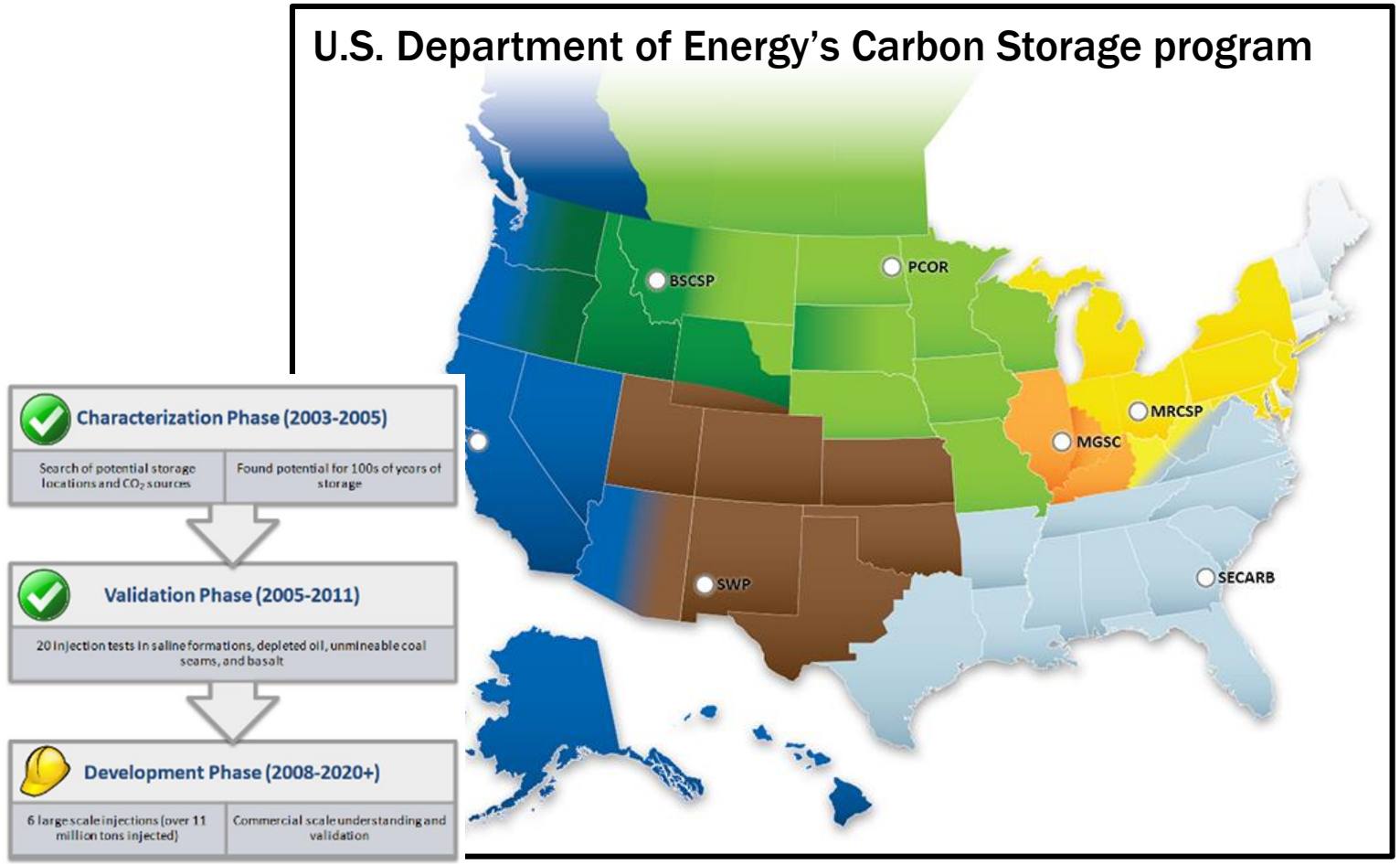
U.S. DOE Regional Carbon Sequestration Partnership Program

- Since 1997, evolution of testing has been replicated in 7 regions in the U.S. to prove up storage resources in the country and develop sound monitoring and environmental practices.



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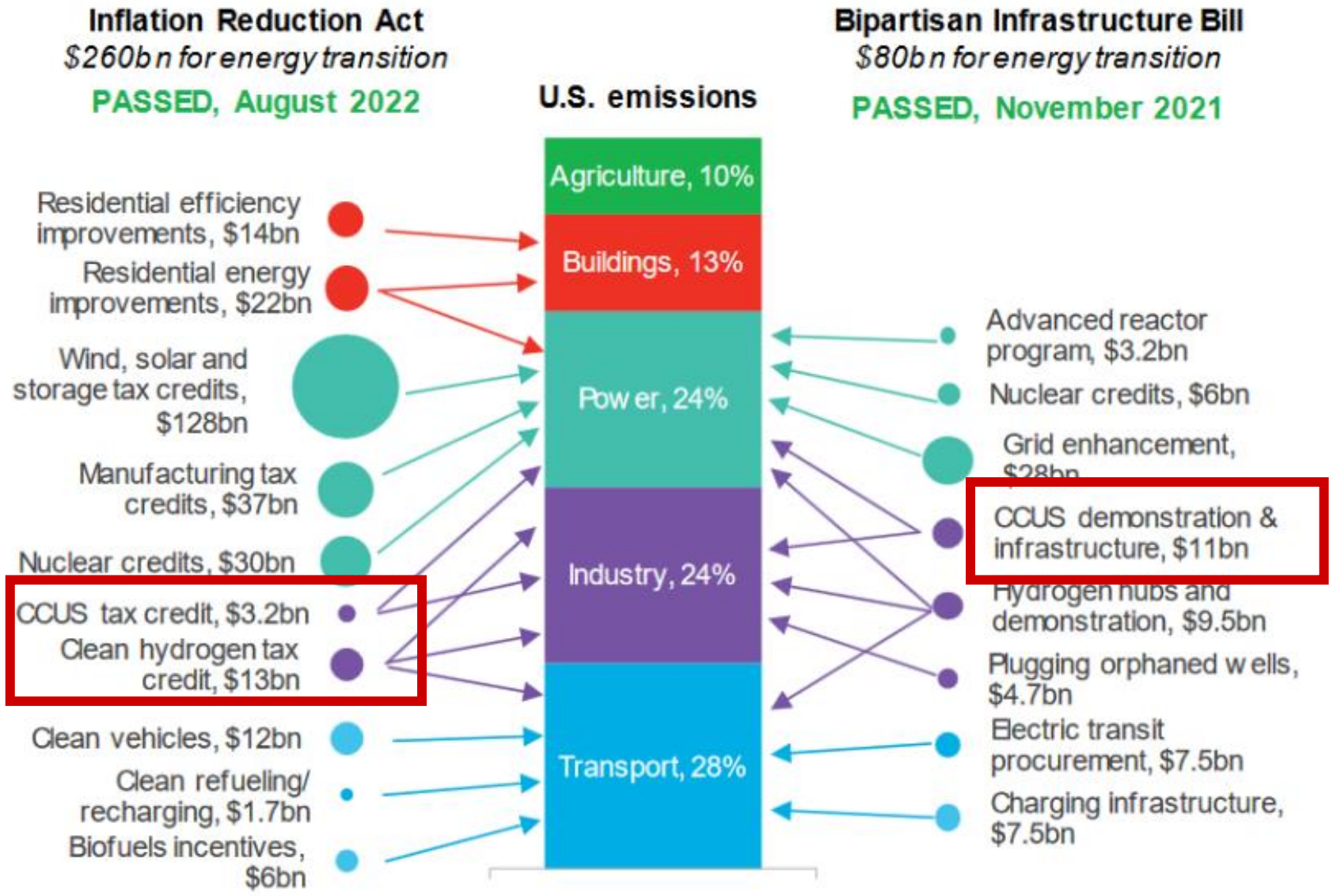
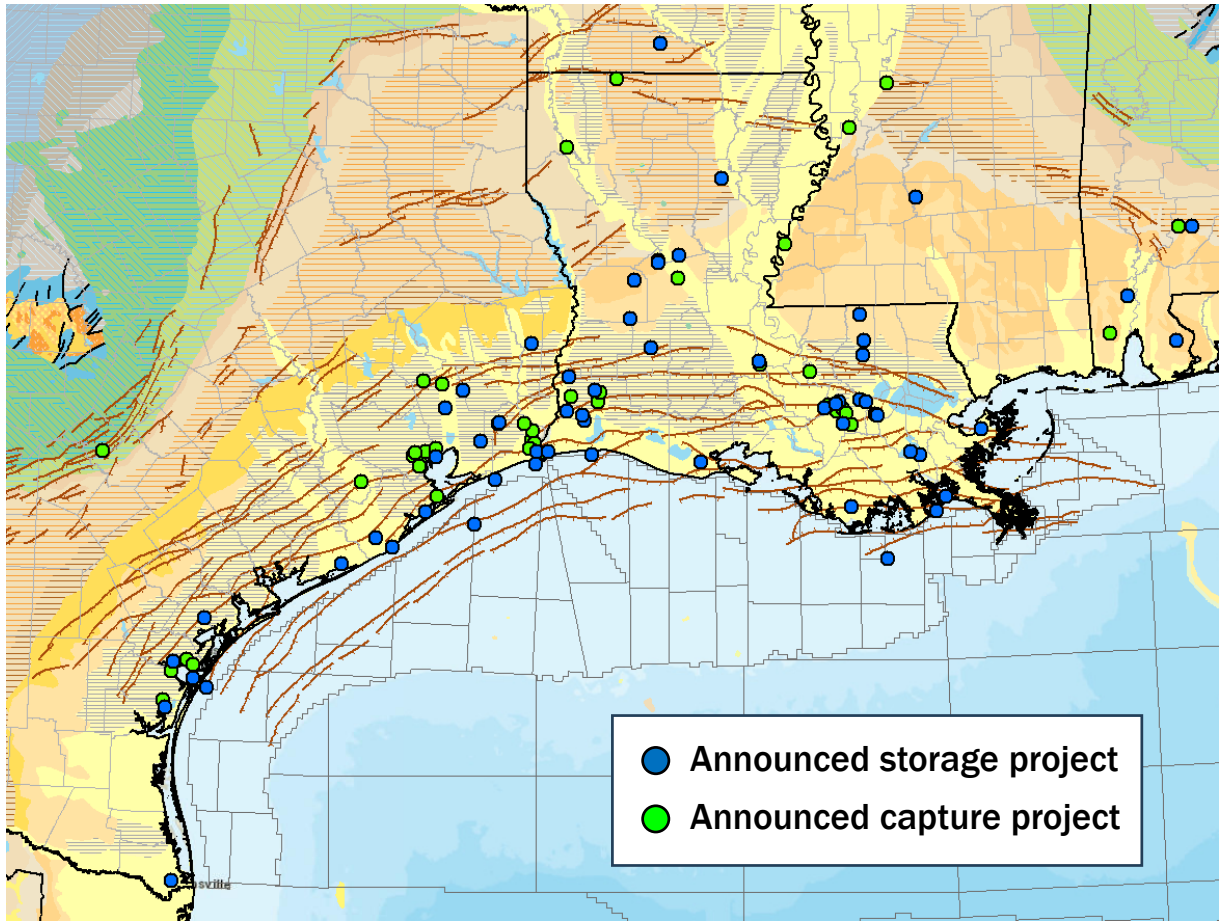
Pro-CCS policy under Biden created a 2-fold increase in projects



Source: EIA, EPA, Joint Committee on Taxation, Inflation Reduction Act, Bloomberg NEF. Note: Left-hand chart only captures tax credits and incentives, not grant programs or loans. CCUS is carbon capture, utilization and storage.

October 4, 2024

Over 55 publicly announced storage projects and over 45 publicly announced capture projects



Project data sources: EPA Class VI tracker, LA DNR, DOE announcements, press releases, company websites, IHS Enerdeq, Geology: USGS

Courtesy of Alex Bump

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Community Backlash – Lake Maurepas Louisiana

Livingston Parish imposes year-long moratorium on injection wells, pausing carbon capture efforts

FOR YOU, FROM ' ADVOCATE

Lake Maurepas is one of the sites for where carbon dioxide would be captured and injected deep underground as part of a larger clean energy project. Louisiana is poised to become a hub for carbon capture technology to curb greenhouse gases but environmentalists and some state climate task force members question if that's such a good thing.

ADVOCATE STAFF PHOTO BY BILL FEIG

BY JACQUELINE DEROBERTIS | STAFF WRITER
SEP 8, 2022 - 8:46 PM

Residents, officials voice opposition to potential carbon capture facilities in Livingston Parish

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ECONOMIC GEOLOGY

Stakeholder Perception Challenges

Technical Issues

- **Putting geologic scales into perspective**
  - Time
  - Mass
  - Volume
- **Understanding geologic mechanisms**
  - Injection, Trapping Mechanisms

Socio-emotional issues

- ***"Hollywood" view of risk***

- ***Lack of trust in industry***
  - Anti-fossil Fuels NOW!

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Learning #1

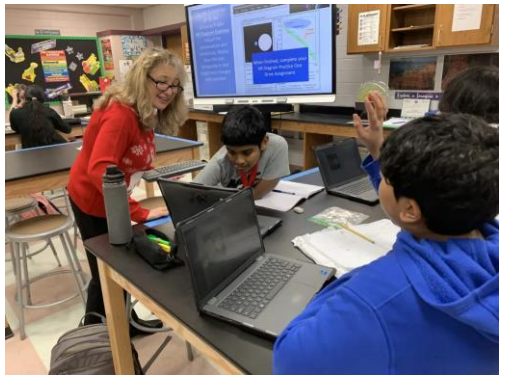
- Get ahead of your projects by EDUCATING communities about the facts of CCS before it reaches their backyards.
- People should feel informed, safe, and even proud to host these projects!
- Involving stakeholders in monitoring is a powerful tool!

GCCC on Outreach Overdrive

State legislature

Regulators

UNFCCC



Teachers and STEM exercises

Information Booths

Summer Schools

International Governments

Public

Media

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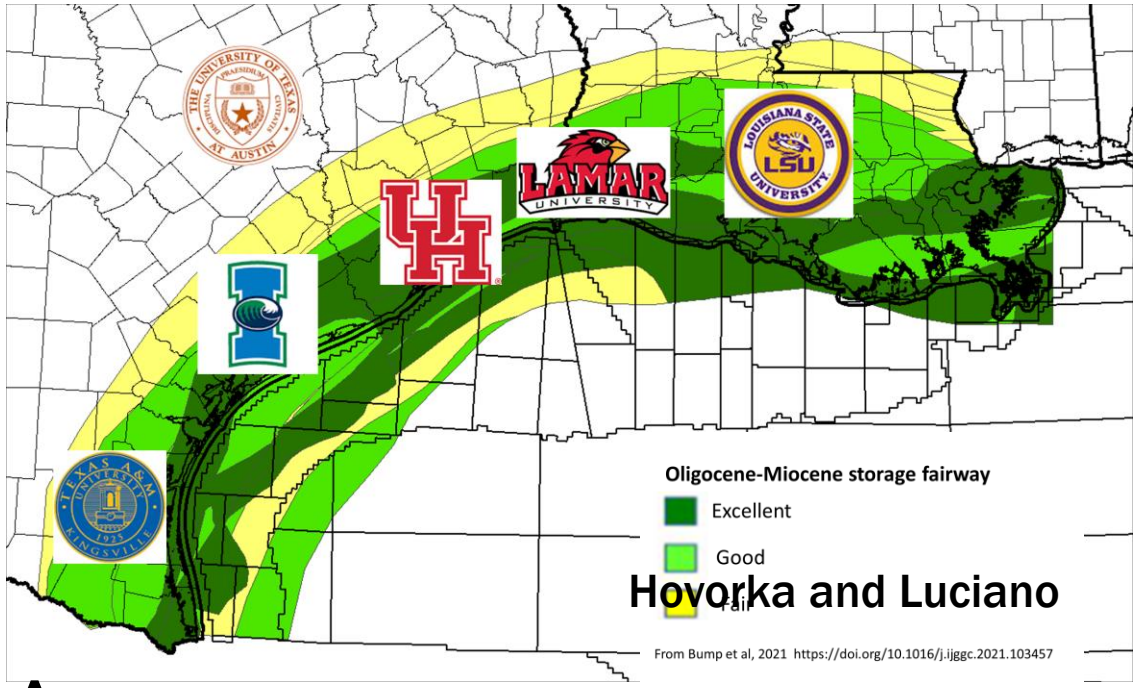
CCS Education Outreach

TXLA CMC
Texas-Louisiana Carbon Management Community



Hovorka and Luciano

- Assess Challenges
- Share Expertise
- Public Engagement

- Data collection & sharing
- STEM curricula development

https://gccc.beg.utexas.edu/research/txla-cmc

Hands-on STEM Exercise

Is Our Water Safe?
Investigating CO_2 Leaks Using Chemistry and the Carbon Cycle

Join the "phonebook"

How Can We Use Environmental Monitoring?

- Environmental monitoring connects the public to the project.
- It answers key questions: Is it safe? Could it leak? What happens if it leaks?
- Involving the public in the science of monitoring builds understanding.
- Participation fosters a sense of ownership.
- It empowers communities to take an active role.
- Simple, transparent methods build trust

What is Environmental Monitoring?

Shallow Subsurface – Assurance that no unwanted outcomes are happening to environment

1. Routine surveillance for signs of leakage
2. Attribute the source of any anomalies – leakage or natural change?
3. Quantify leaks to atmosphere

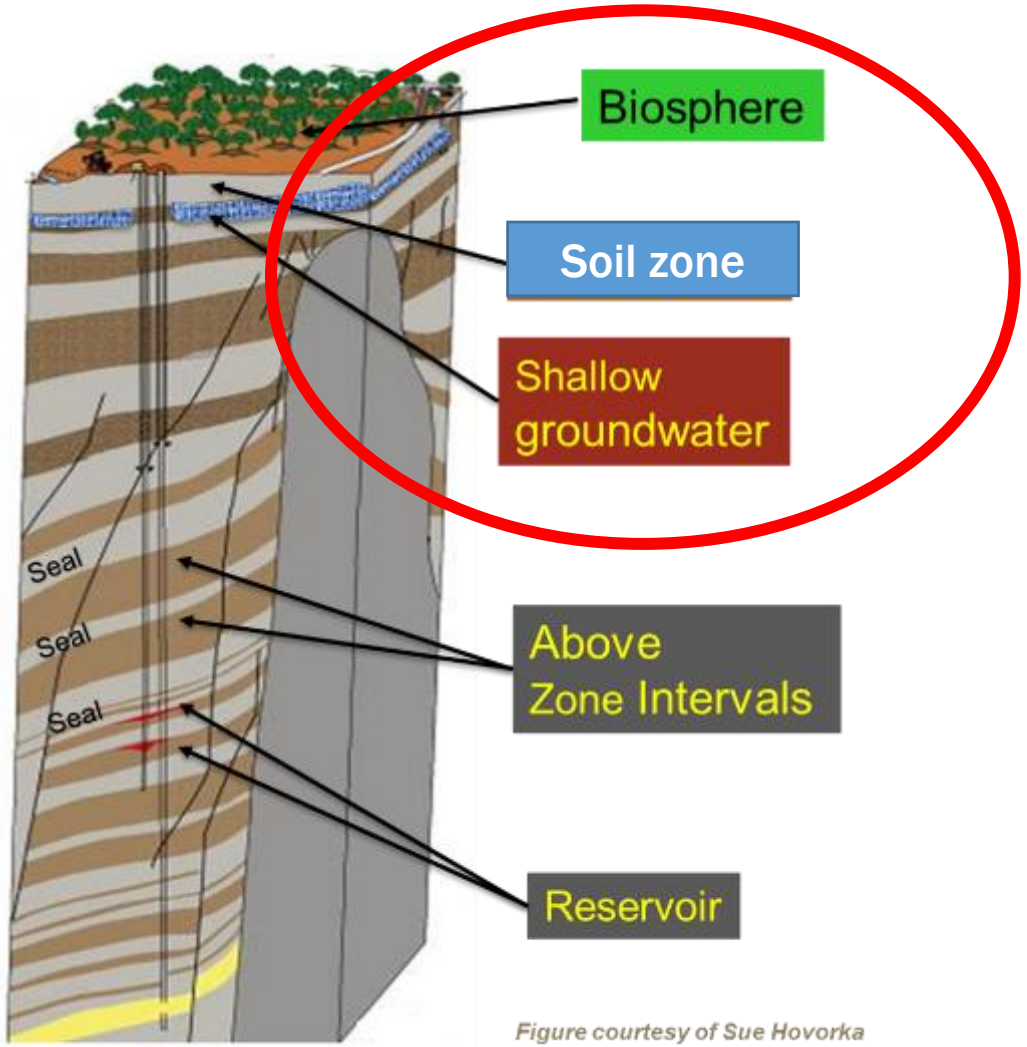
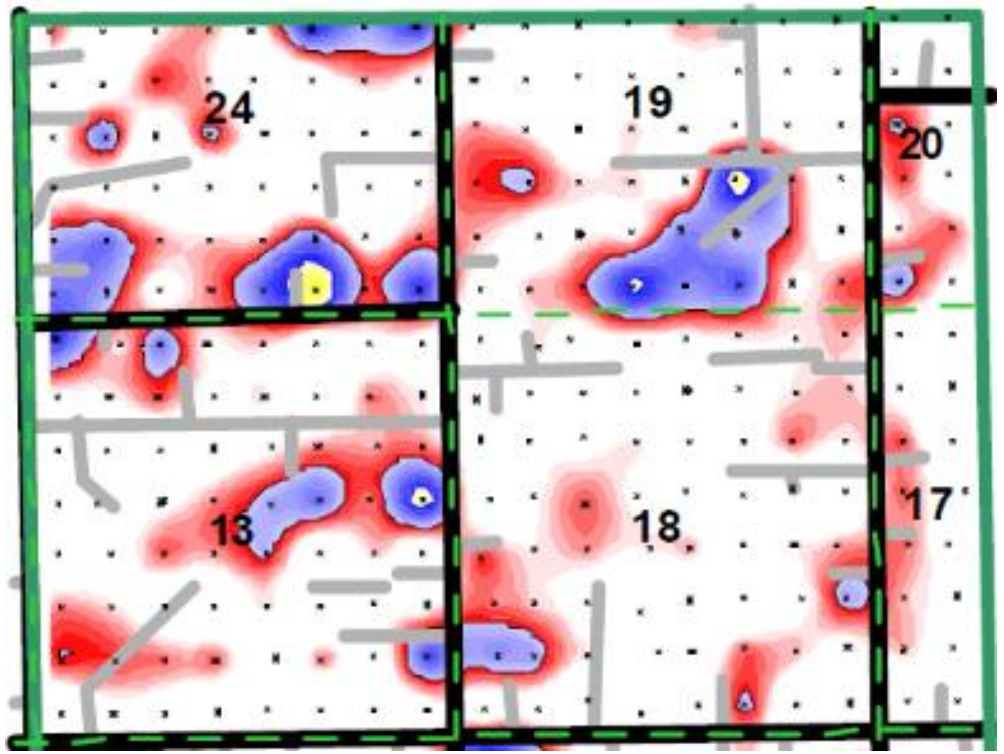


Figure courtesy of Sue Hovorka

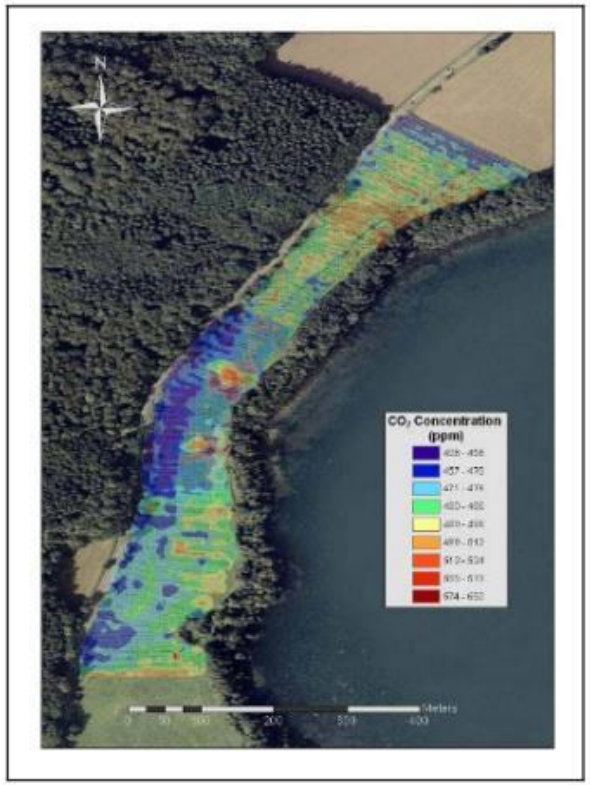
CO_2 Attribution

In-situ CO2 produced by soil organisms



Weyburn soil-gas grid: 14 km^2, 200 m spacing. Jones et al., 2006, Soil Gas Monitoring at the Weyburn Unit in 2005

Volcanic CO_2 coming from depth



Walking traverses over gas vents at Latera with the ground surface measurement system (infrared analyzer) measuring CO2 concentrations (Jones et al. 2009)

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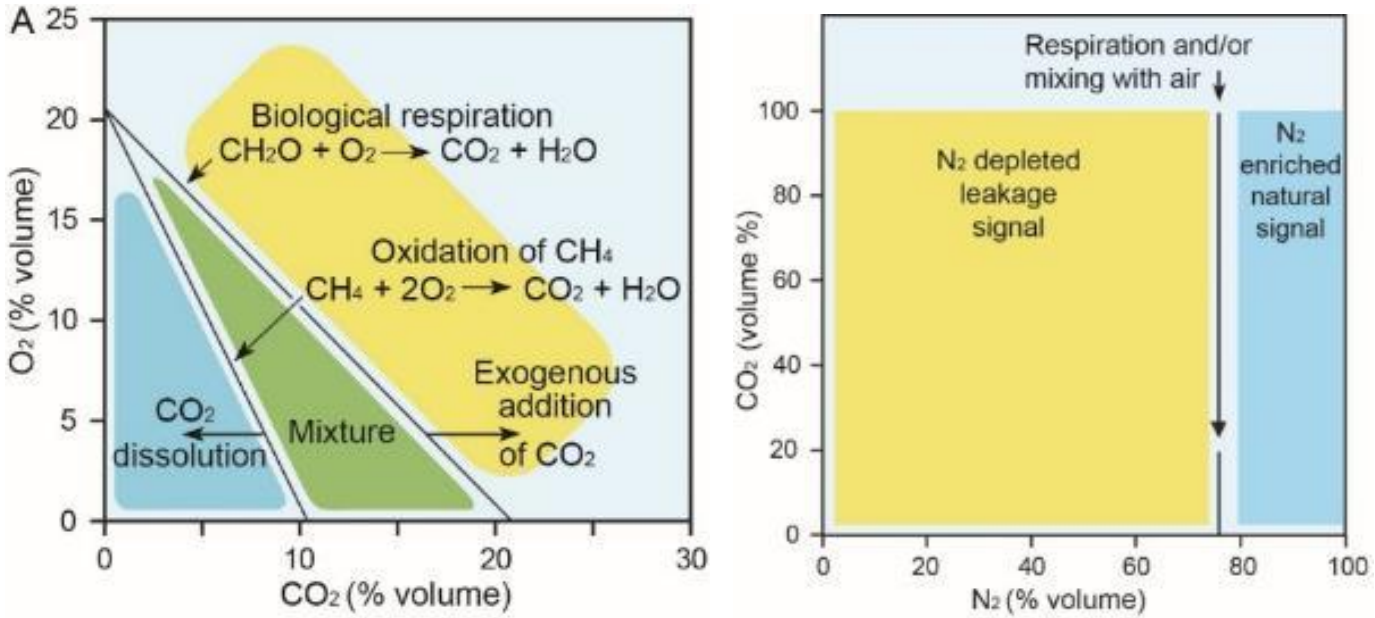
Process-Based Soil Gas Ratios

- Uses simple gas relationships to identify **processes.**
  - Biologic respiration
  - Methane oxidation
  - Dissolution
  - Leakage
- No need for years of background
- One time characterization
- Method can be applied in any environment regardless of variability



Romanak et al., 2014, International Journal of Greenhouse Gas Control, 30, 42-57
Romanak et al., 2012, Geophysical Research Letters, *39* (15).

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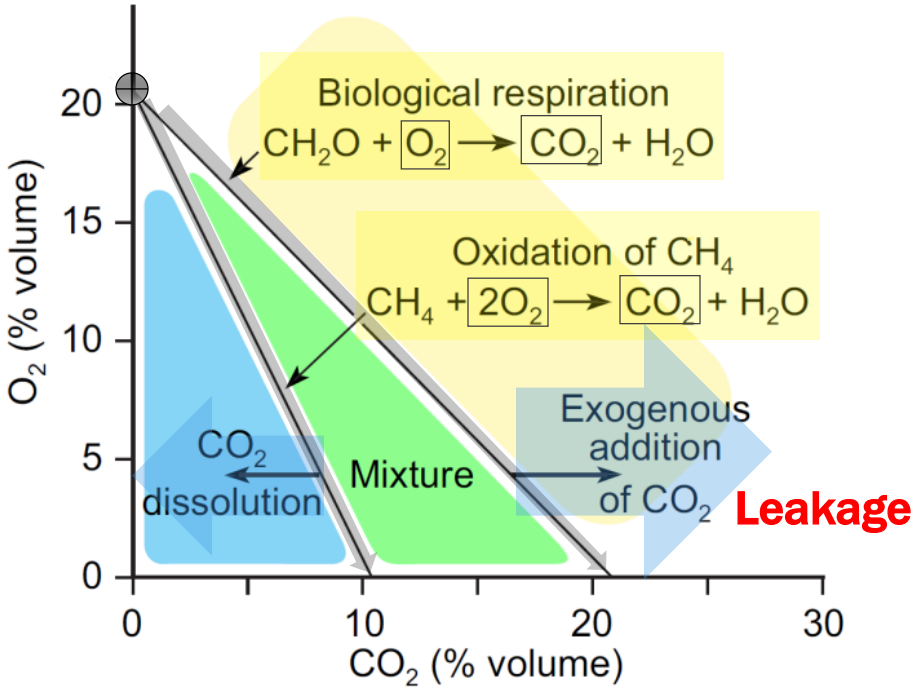
Process-Based Example

- Uses geochemical relationships to identify key processes rather than concentration comparisons



Case Study- 2011 Kerr Leakage Allegation

- IEAGHG Weyburn CO_2 Monitoring and Storage project, Saskatchewan Canada
- Perceived environmental change was blamed on the CO_2 storage project
- Protocols for responding to stakeholder concerns were not in place
- Unexperienced consultant wrongly attributed leakage


THE GLOBE AND MAIL

IN PICTURES

Carbon capture leak forces Saskatchewan couple to leave farm

Published Tuesday, Jan. 11, 2011 6:12PM EST

Pair abandon Saskatchewan farm because of blowouts, dead animals and algae

1 of 10

(Troy Fleece/The Canadian Press)

Show caption

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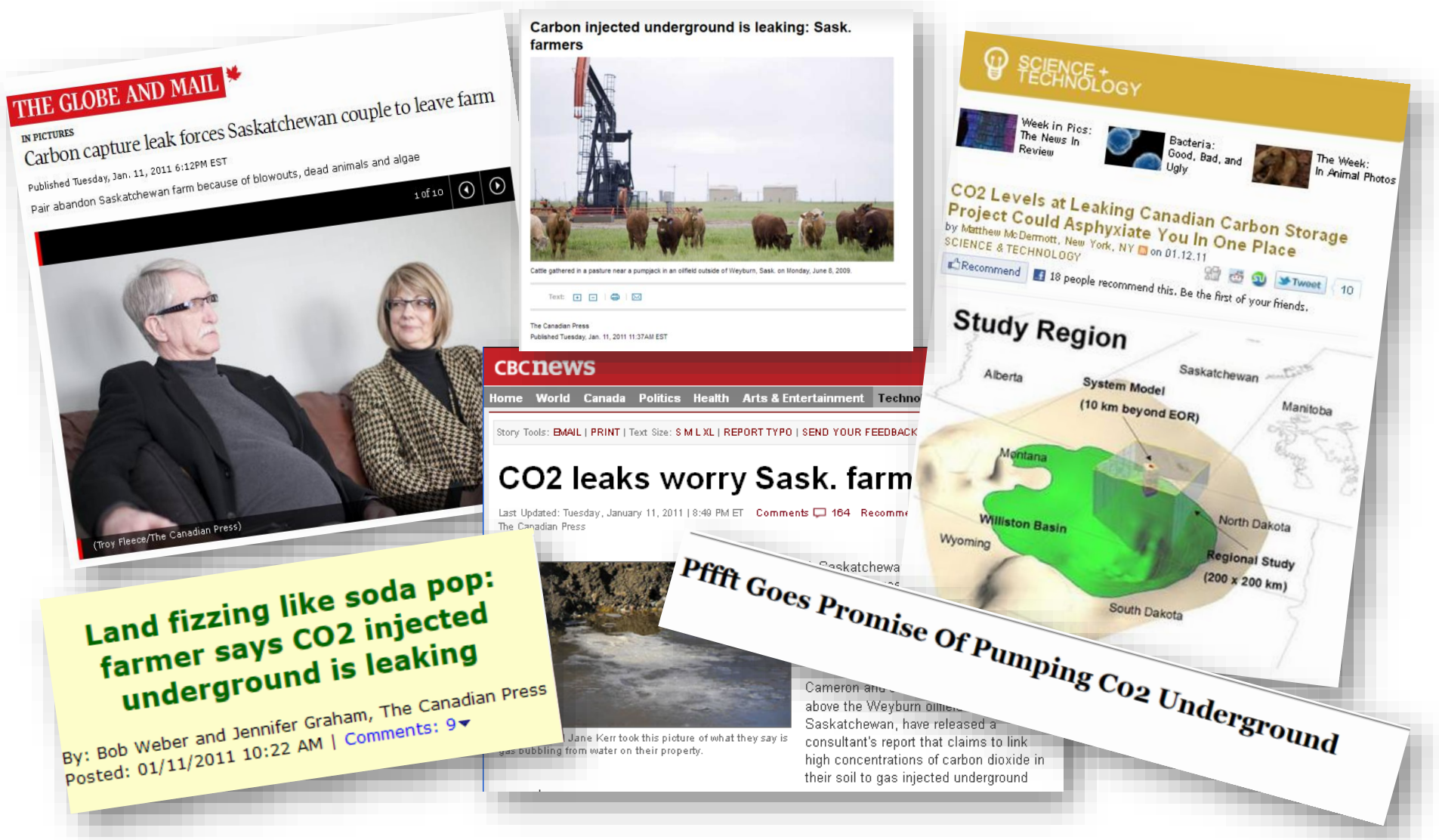
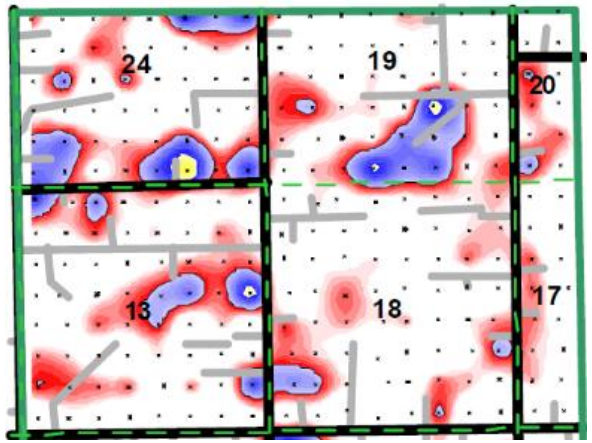
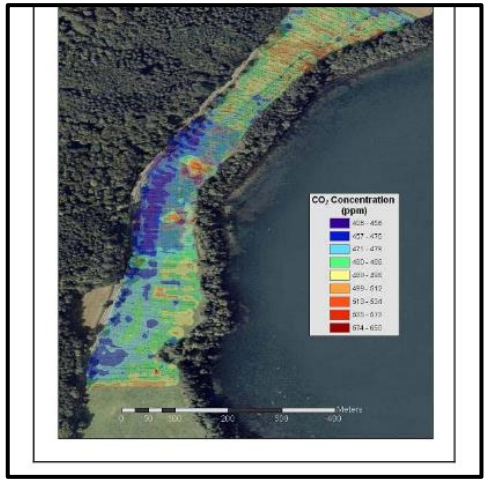
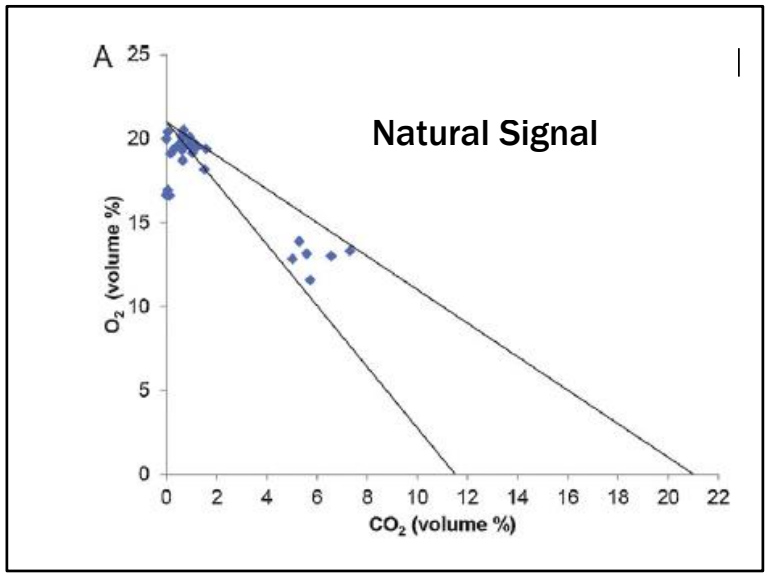
Negative Media Storm

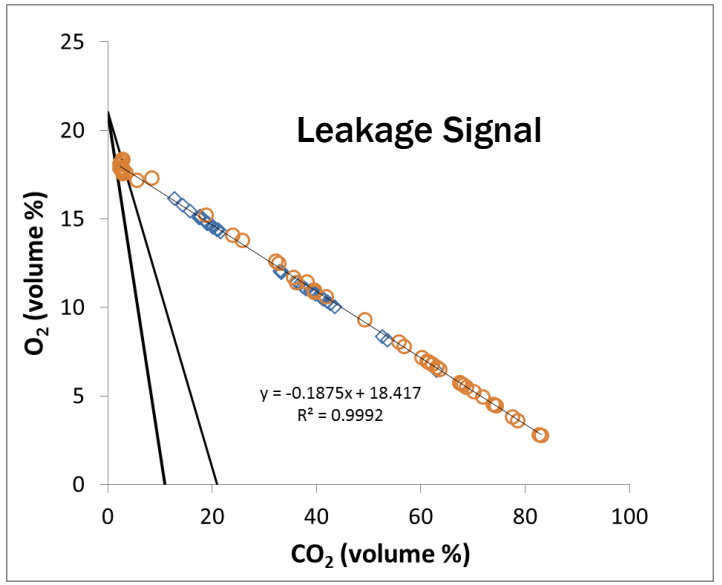


Process-based Attribution









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Leakage Allegation Discounted

"In a media release, Ecojustice lawyer Barry Robinson, who represented the Kerrs, accepted the IPAC-CO2 study's findings while emphasizing its necessity, saying that "without a full scale investigation, it has been impossible until now to rule out CO_2 contamination."


ecojustice

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FOR IMMEDIATE RELEASE

Long-awaited investigation into CO2 impacts a 'win for all Canadians'

DEC 12, 2011 09:37 AM


ACCN Canadian Chemical News L'Actualité chimique canadienne

Weyburn CO_2 leak a false alarm

By Tyler Irving
Posted February 2012

In January 2011, Cameron and Jane Kerr alleged that CO_2 from a nearby experimental carbon storage project was leaking onto their farm near Weyburn, Sask. A year later, two independent investigations have concluded that this is not the case.

The project consists of piping CO_2 from a coal gasification plant in North Dakota into an oil field operated by Canadian oil company Cenovus. Last summer, Cenovus contracted TRUE Environmental to undertake extensive soil and surface water sampling operations on the property. The results, delivered last November, show CO2 concentrations consistent with what is commonly found in prairie soil gas in summer. Moreover, carbon levels were inversely correlated with oxygen levels, a sign that the CO_2 was produced by biological respiration. Finally, the presence of unstable ^{14}C indicated a young carbon source. Since ^{14}C has a half-life of about 5,730 years, it would have been absent in CO_2 from the several million-year-old coal deposits.

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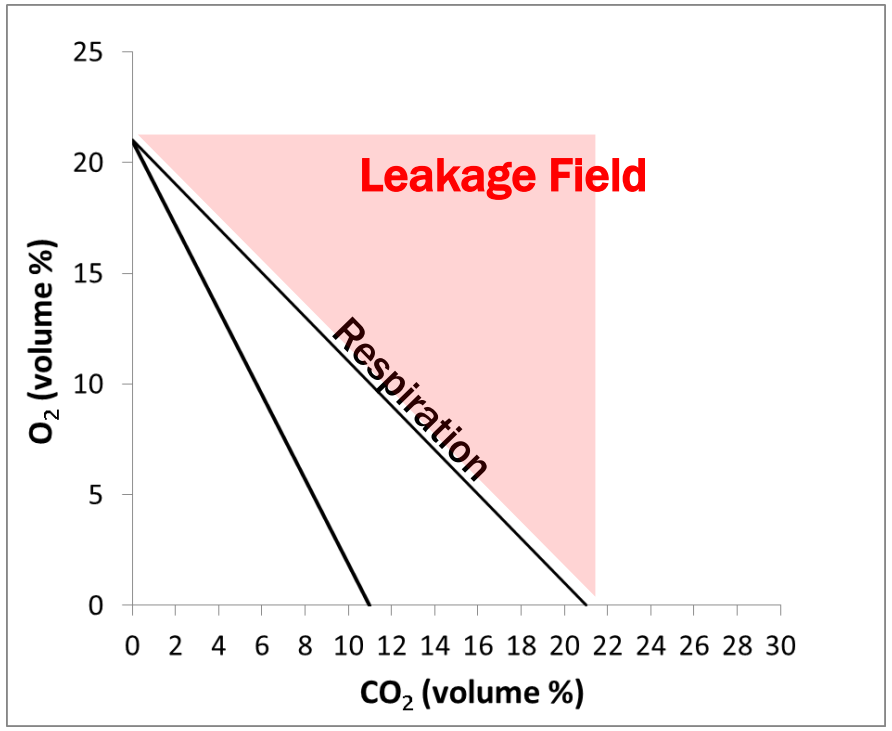
Learning #2

- Environmental change resulting from climate change will cause stakeholders to question the storage project
- When CCS is fully deployed, responding to stakeholders concerns may be our main activity.
- Develop fast accurate stakeholder-friendly methods with clear thresholds
- Methods that are easily communicated to stakeholders are needed

Ratios Providing "User-Friendly" Monitoring

- Respiration line as a universal trigger point
- No need for years of baseline- only need a one-time characterization.
- Easy to explain and engage stakeholders
- Instant data reduction and graphical analysis



Katherine Romanak BEG

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Denham Springs Sharks

Samsung Solve For Tomorrow STEM Team

The school children identified the need to involve their community in monitoring so they developed a tool!

Randy Delatte
Livingston Parish President

"There's a lot of unknowns for elderly people like myself when it comes to Carbon Capture. It is a new word we just heard of a couple of years ago. We hear all these horror stories but what's fact and what's fiction?"


THE ADVOCATE LOG IN

Denham Springs STEM team is national finalist for the 15th Samsung Solve for Tomorrow competition

Community news report Apr 8, 2025 2 min to read

BATON ROUGE • ASCENSION • LIVINGSTON • WEST BATON ROUGE • TANGIPAHOA •

METRO

THEADVOCATE.COM | SUNDAY, FEBRUARY 23, 2025 1B

Louisiana students develop app

Denham Springs residents will be updated on Lake Maurepas

BY CLAIRE GRUNEWALD
Staff writer

As the carbon capture and sequestration industry grows in south Louisiana, a group of Denham Springs students is developing an innovative way to keep the community informed about it.

Called the Denham Springs High School Sharks, the student STEM group has spent the past few months monitoring Lake Maurepas using sensors and relaying the information to a mobile app. The idea is to keep area residents in the know about what is

➤ See STUDENTS, page 2B

PROVIDED PHOTO
Denham Springs High Stem Center Design Sharks members Khadija Henni, left, and Adalyn Farrell work on editing app codes.

Summary and Recommendations

- Get ahead of your projects by EDUCATING communities about the facts of CCS before it reaches their backyards. Using STEM curriculum is currently proving to be impactful
- Both technical (how it works) and socio-emotional challenges (trust and community benefits) should be addressed.
- Regulations require environmental monitoring for leakage detection, but attribution is extremely important and complex and needed to respond to concerns.
- Involving stakeholders in monitoring is a powerful tool!
- Environmental changes resulting from climate change may cause stakeholders to question the storage project. A protocol should be in place before a project begins for responding to stakeholder concerns.
- Develop fast accurate stakeholder-friendly methods with clear thresholds that are easily communicated to stakeholders
- A process-based soil gas approach is an excellent tool for engaging stakeholders in monitoring because it is inexpensive, simple to understand with transparent methods.

Thank You

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http://www.beg.utexas.edu/gccc/