Monitoring Instrumentation for Carbon Capture and Storage Projects

Bill Miller

Senior Product Manager

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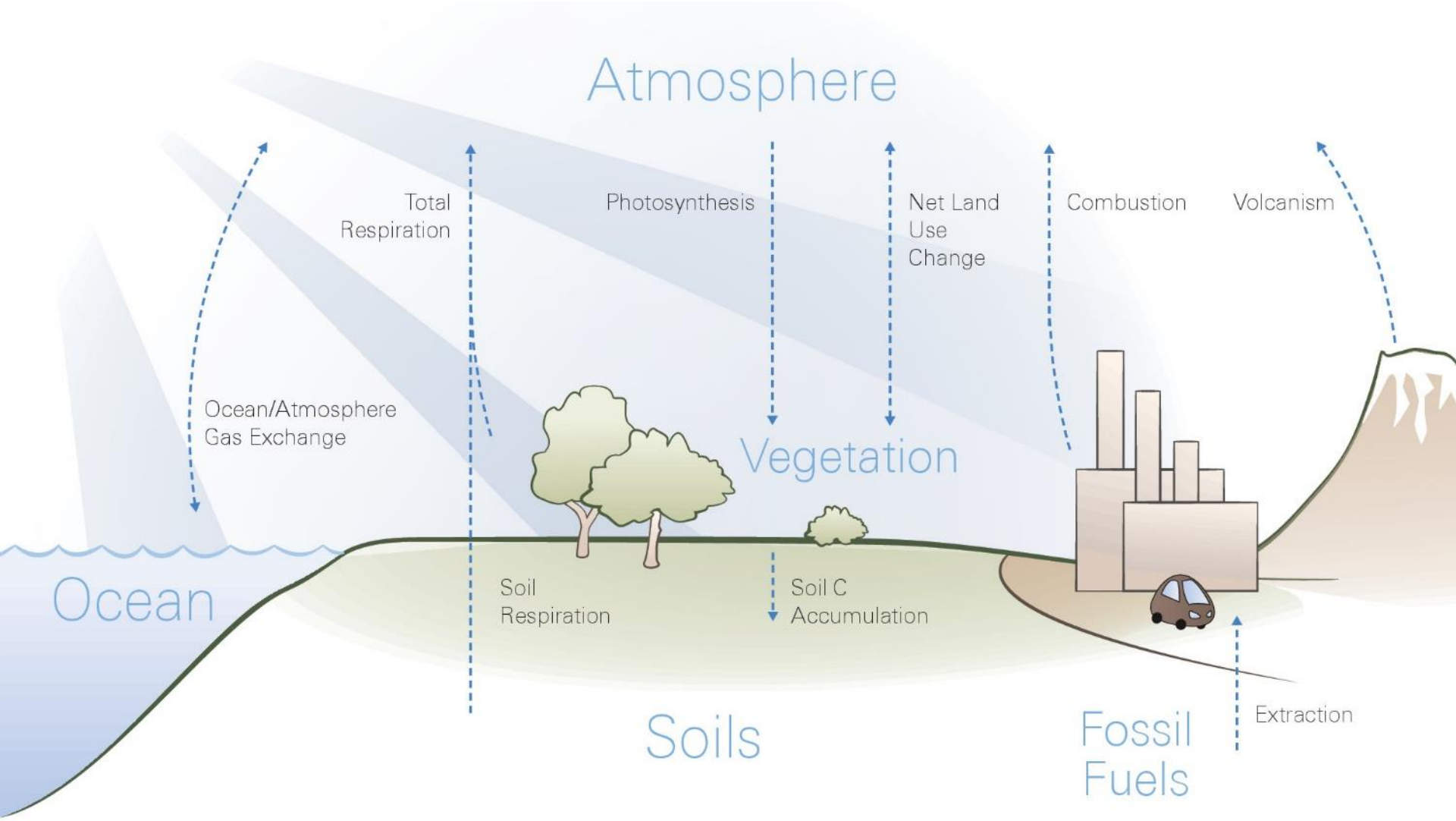
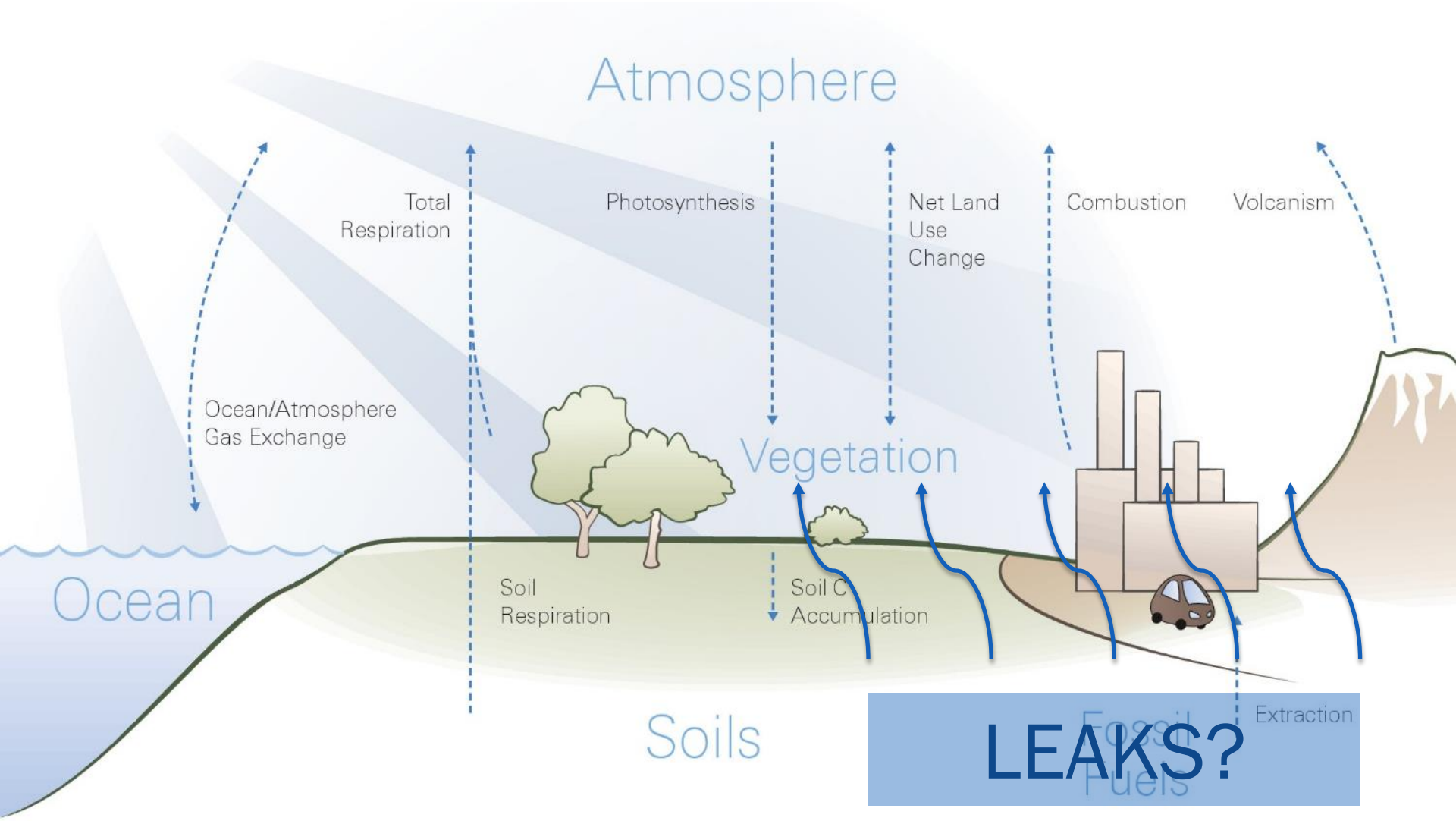
Canopy Carbon Balance



Canopy Carbon Balance



Why Surface Monitoring?

- Demonstrate that storage is permanent
- Track migration over time
  - Validation and calibration of model predictions and monitoring tools
- Assure the public that human health and the environment are high priorities
  - Establish baseline conditions
  - Provide early warning of storage leaks and diagnosis of why storage may leak

Monitoring Scales

Soil Surface

Atmospheric

Spatial Sampling

Temporal Sampling

Spatial and Temporal

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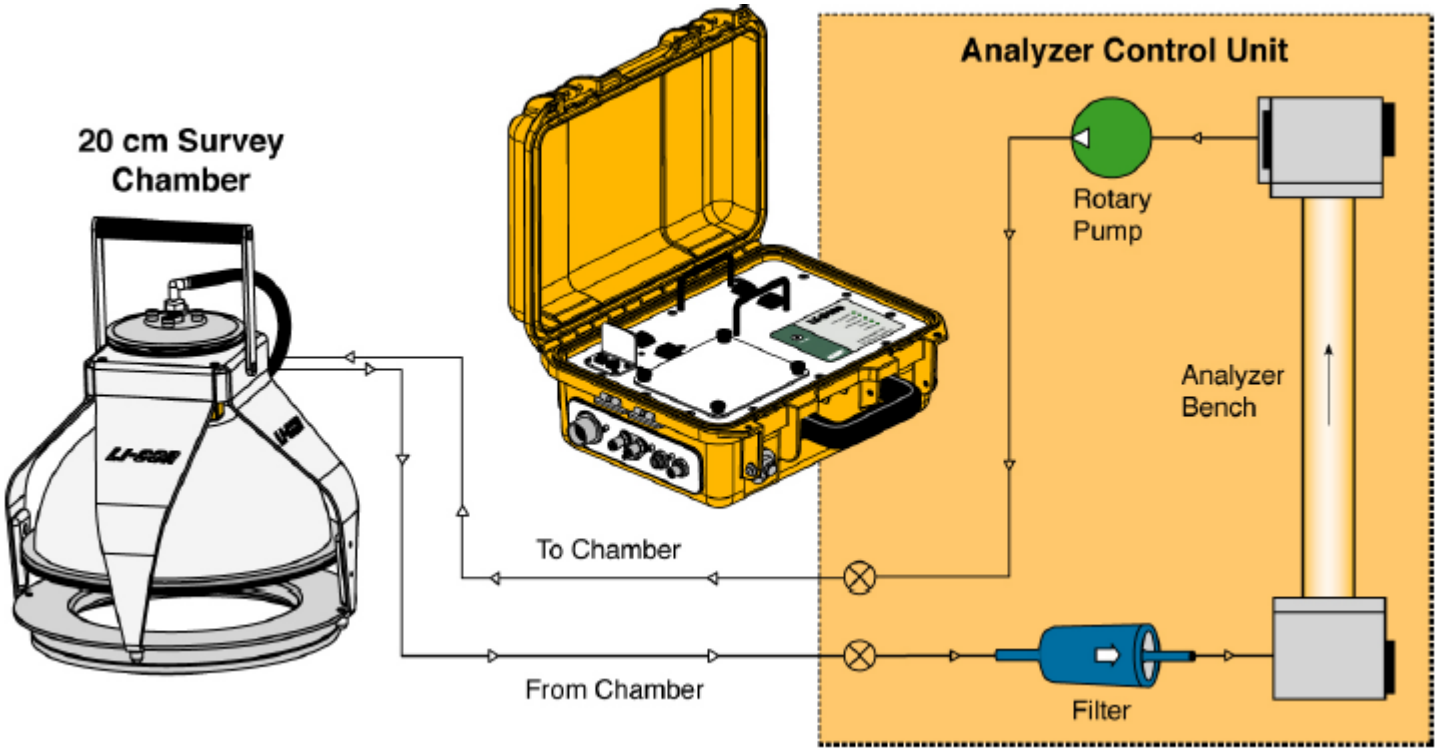
Requirements for a good measurement

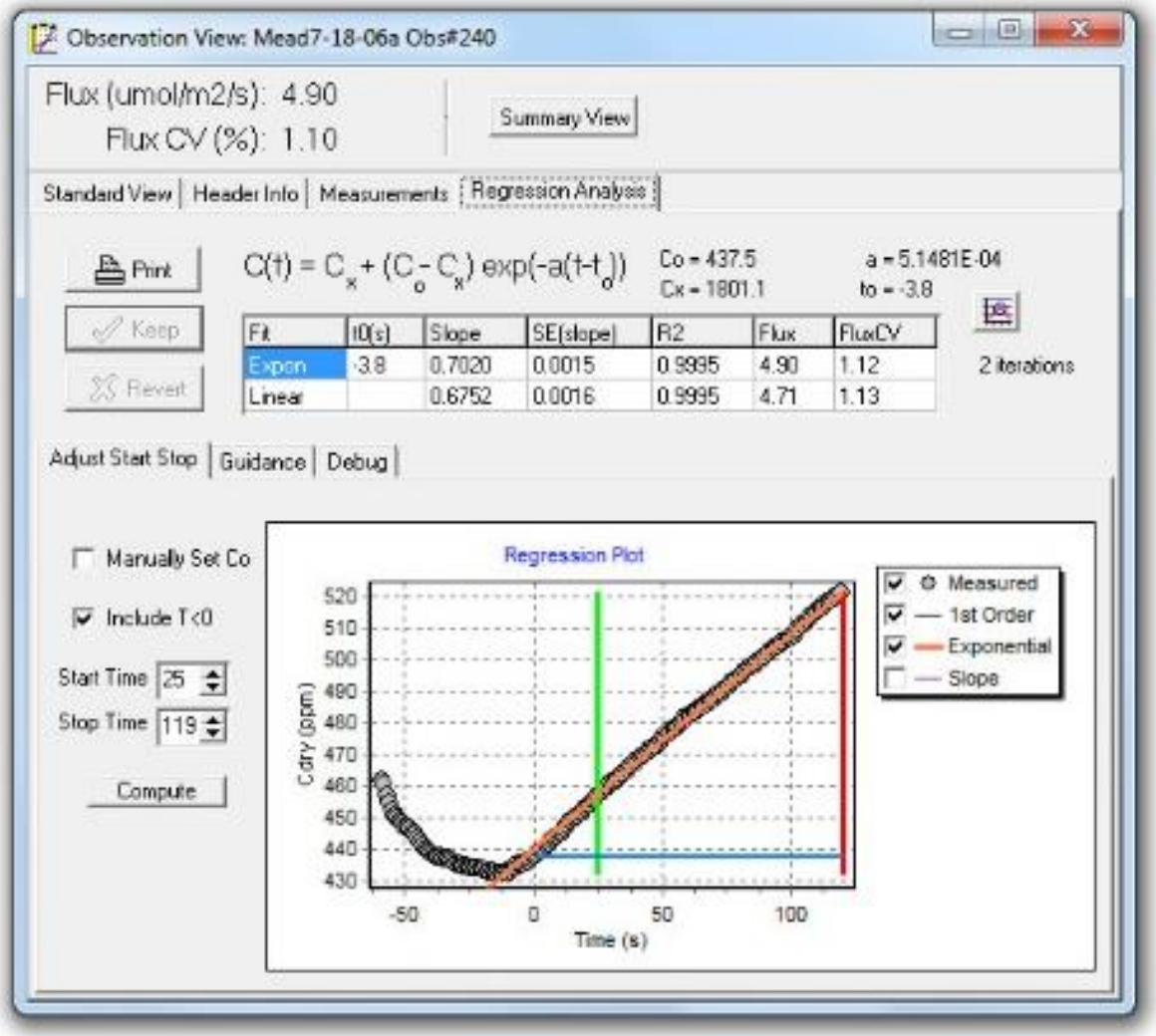
- CO_2^{soil} not disturbed
- $P_{bench} \sim P_{ambient}$
- $CO_2^{chamber} = CO_2^{air}$
- $P_{chamber} = P_{ambient}$
- Good mixing

Requirement: CO_2^{soil} Not Disturbed

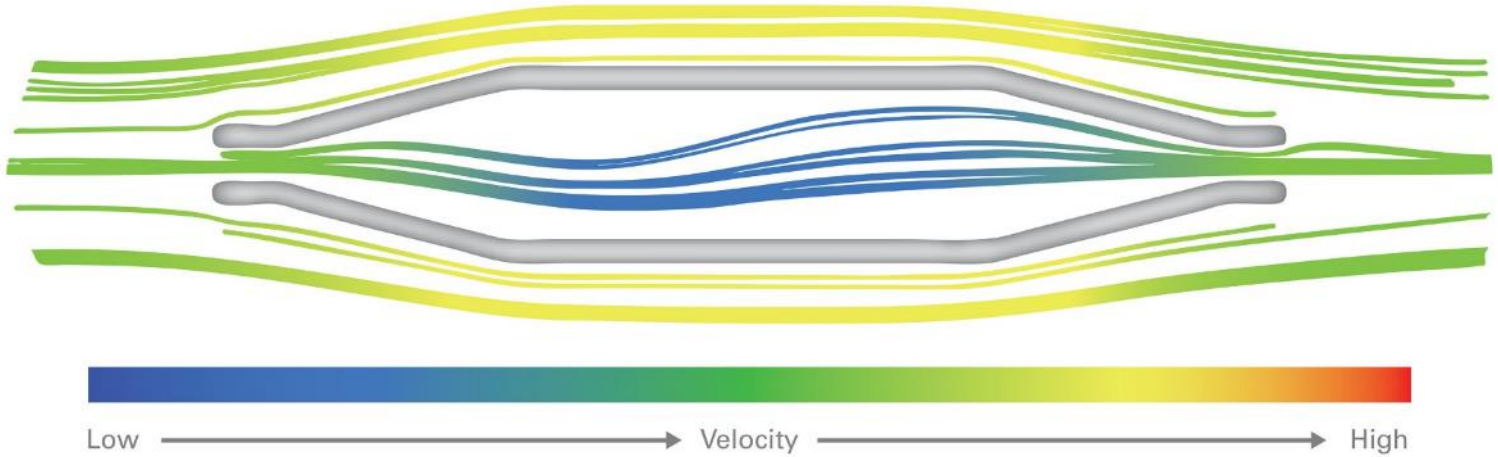
Requirement: $P_{bench} \sim P_{ambient}$



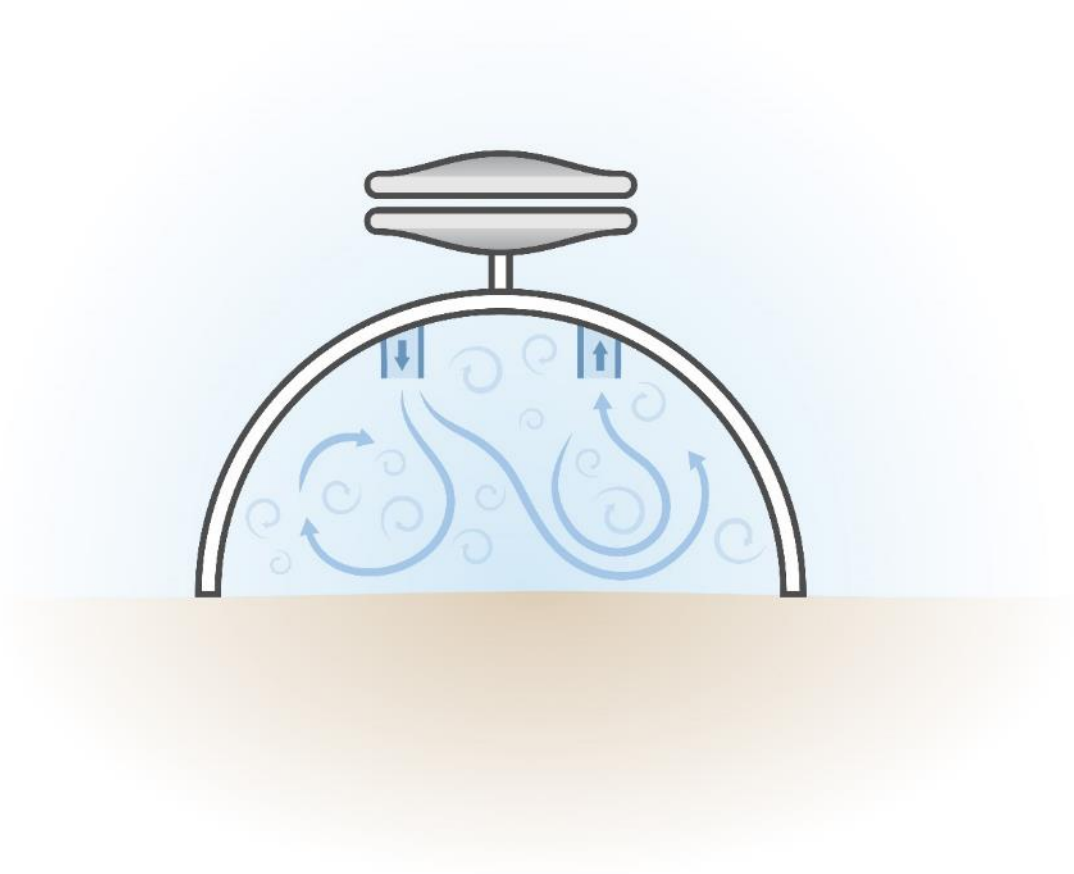
Requirement: $CO_2^{chamber} = CO_2^{air}$



Requirement: $P_{chamber} = P_{ambient}$

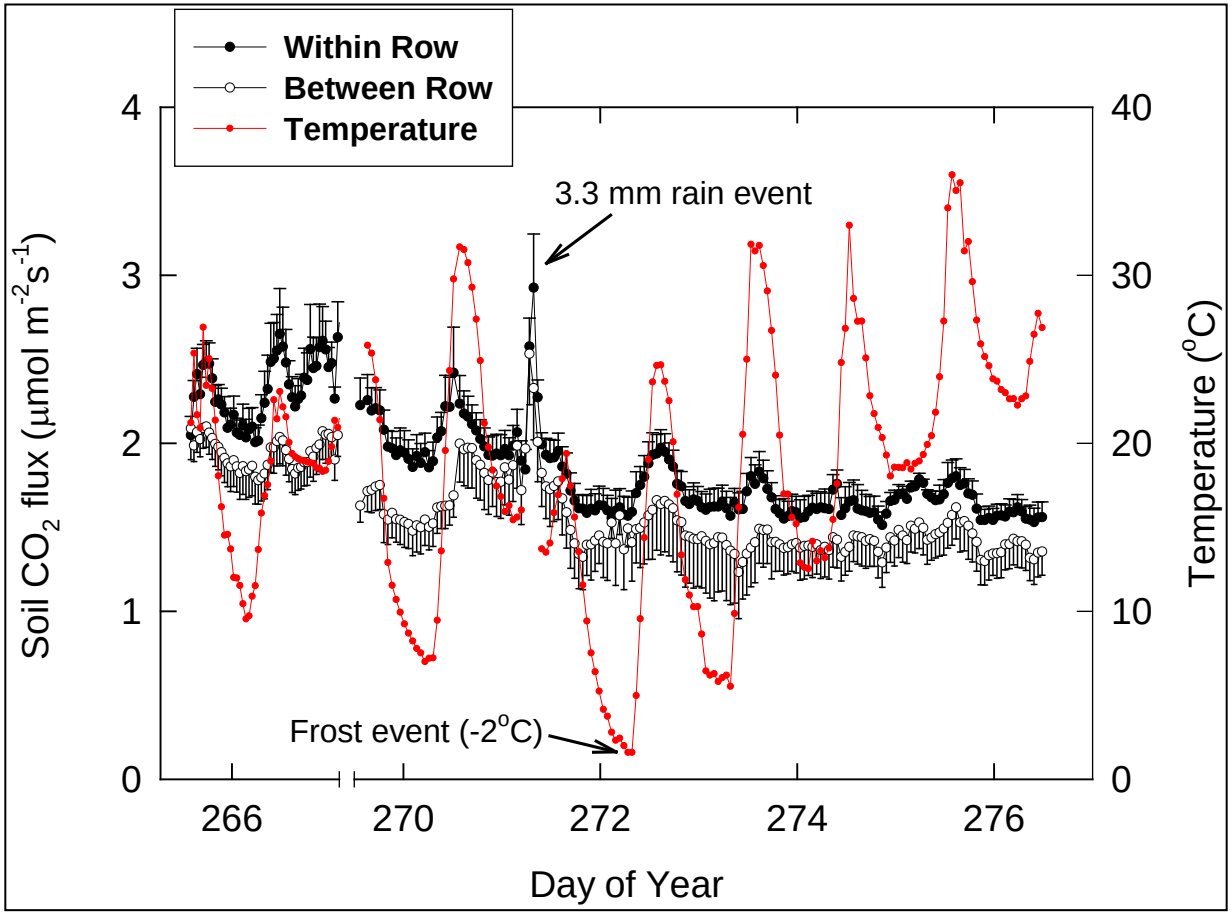


Requirement: Good Mixing



Mead Corn Field Testing

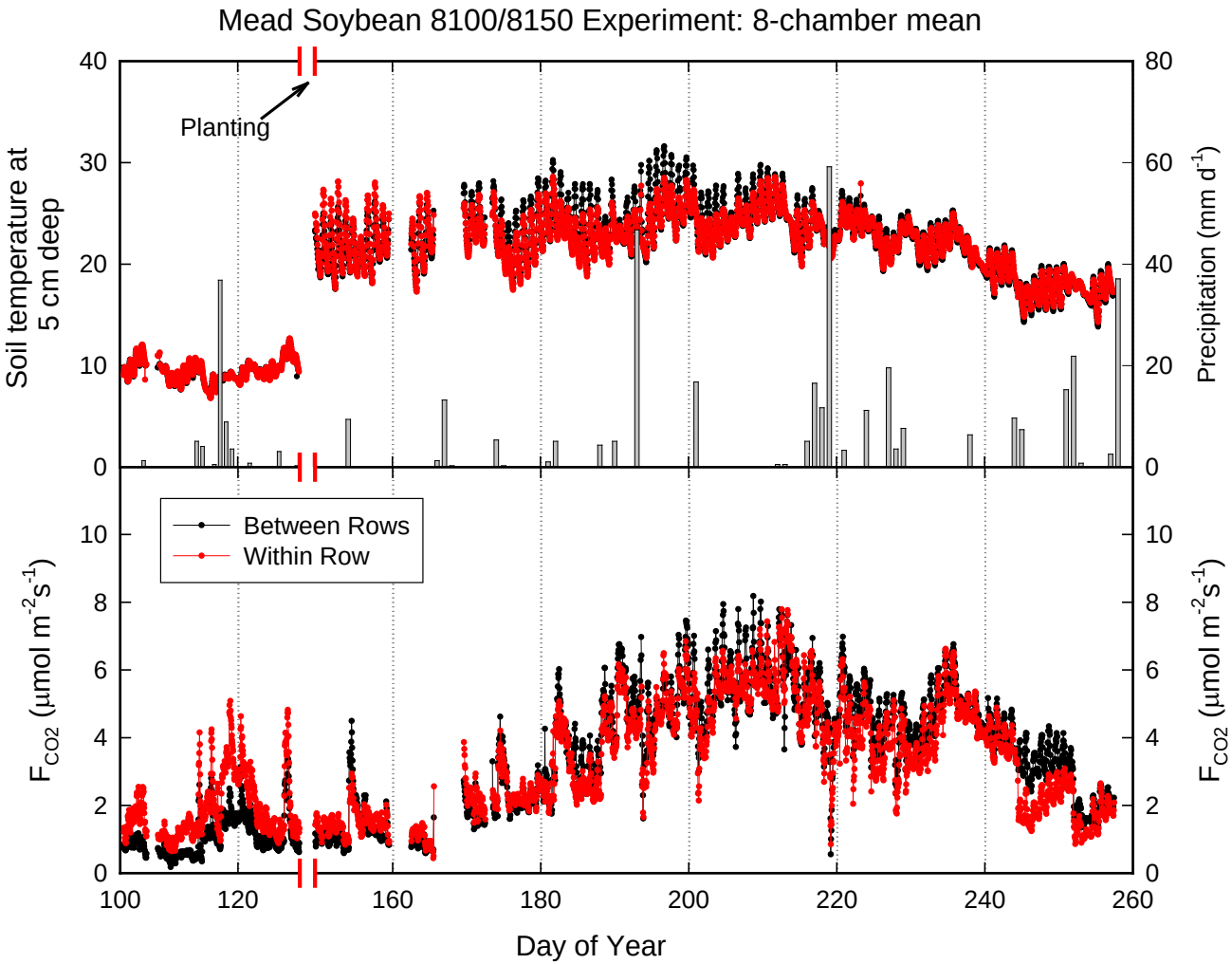
Results: Mead Corn Field



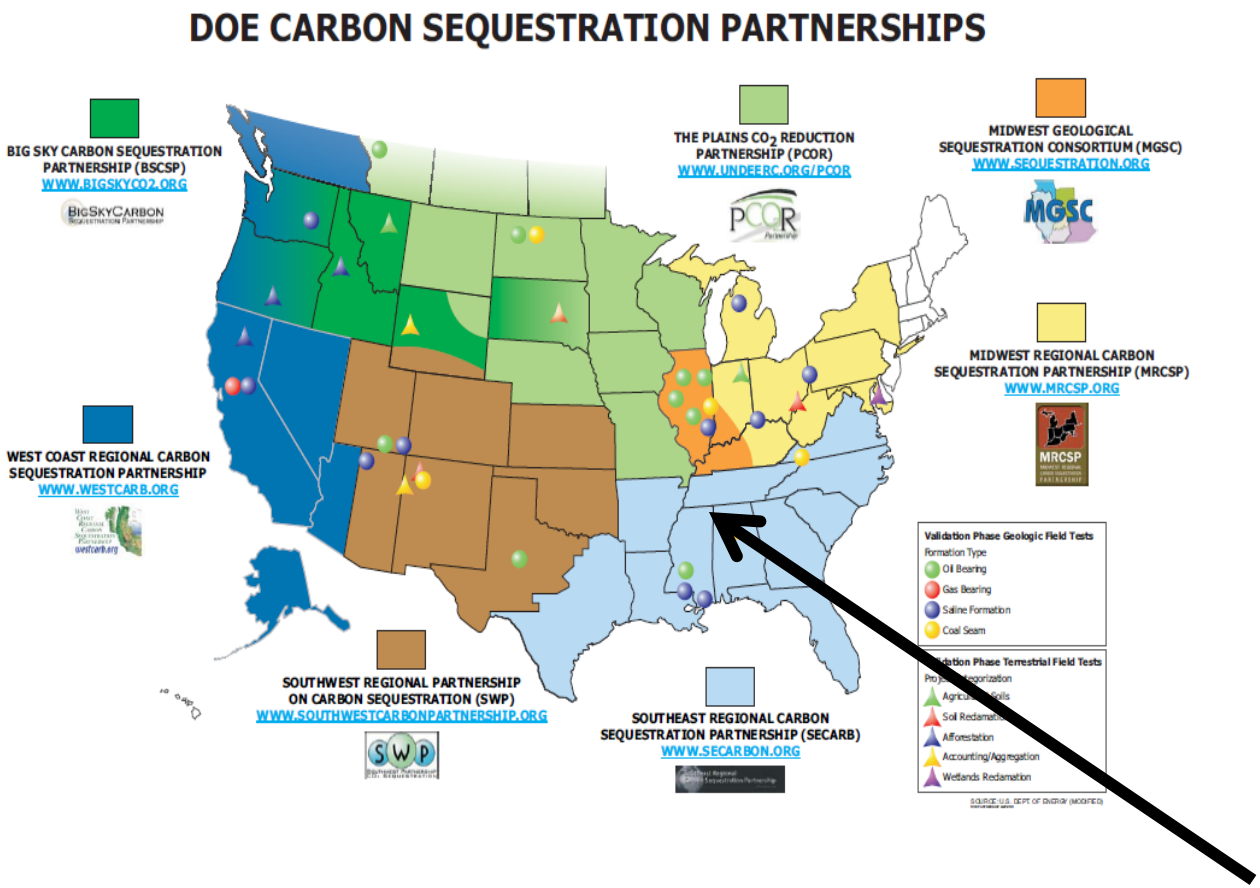
June

September

Results: Mead Soybean Field

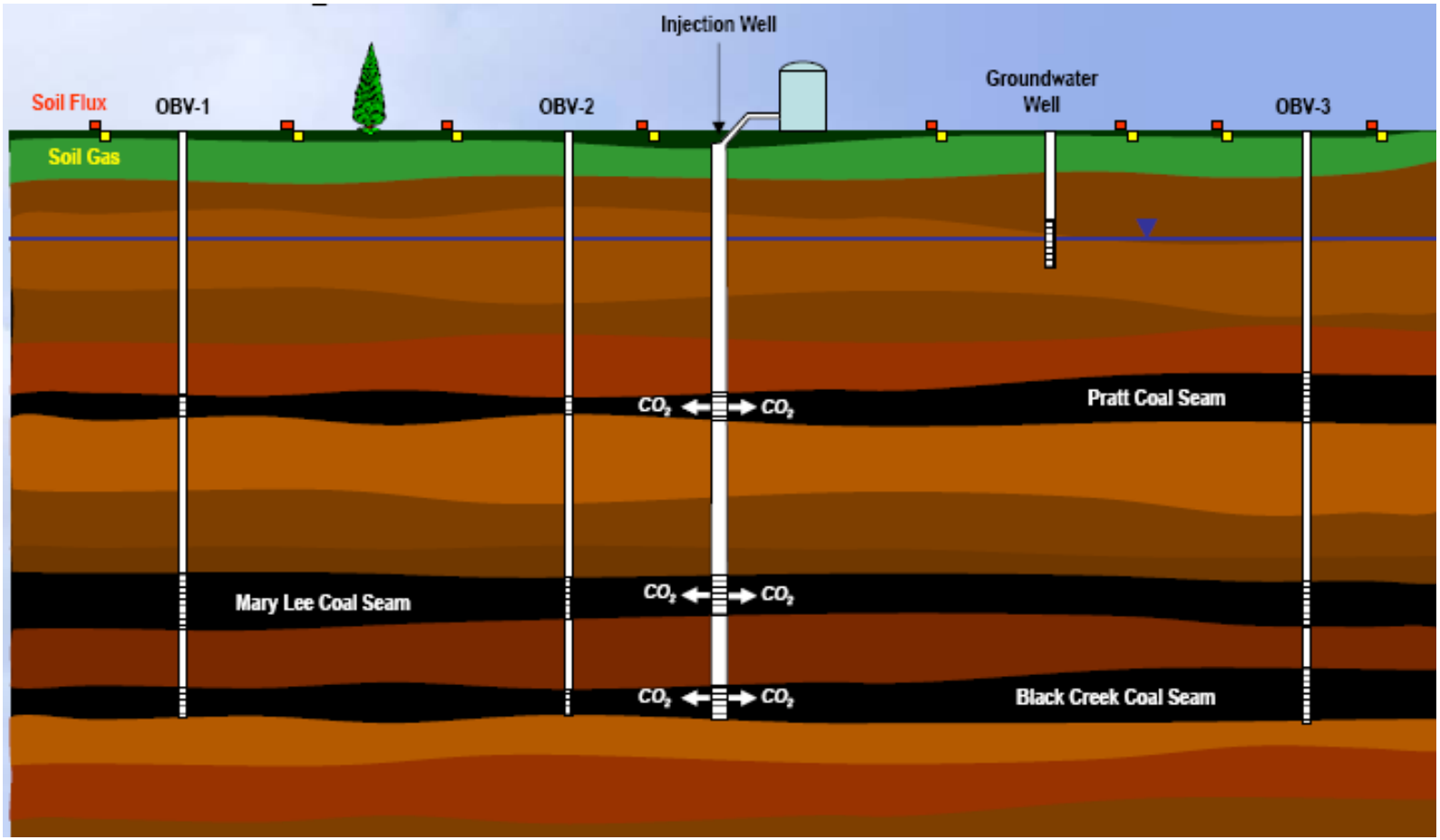


SECARB

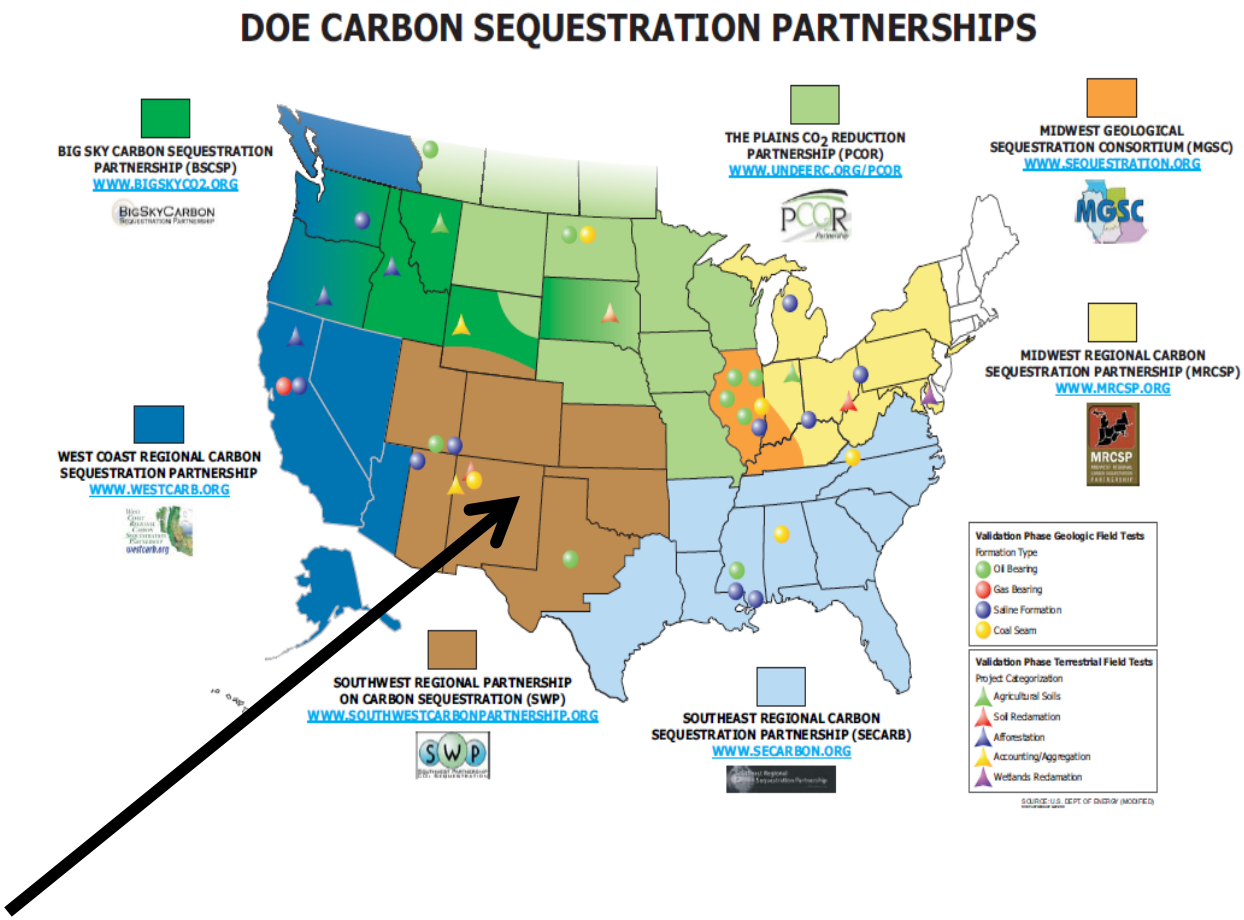

DOE CARBON SEQUESTRATION PARTNERSHIPS
BIG SKY CARBON SEQUESTRATION PARTNERSHIP (BSCSP)
WWW.BIGSKYCO2.ORG
THE PLAINS CO2 REDUCTION PARTNERSHIP (PCOR)
WWW.UNDEERC.ORG/PCOR
MIDWEST GEOLOGICAL SEQUESTRATION CONSORTIUM (MGSC)
WWW.SEQUESTRATION.ORG
MIDWEST REGIONAL CARBON SEQUESTRATION PARTNERSHIP (MRCSP)
WWW.MRCSP.ORG
WEST COAST REGIONAL CARBON SEQUESTRATION PARTNERSHIP
WWW.WESTCARB.ORG
SOUTHWEST REGIONAL PARTNERSHIP ON CARBON SEQUESTRATION (SWP)
WWW.SOUTHWESTCARBONPARTNERSHIP.ORG
SOUTHEAST REGIONAL CARBON SEQUESTRATION PARTNERSHIP (SECARB)
WWW.SECARBON.ORG
Validation Phase Geologic Field Tests
Formation Type
Oil Bearing
Gas Bearing
Saline Formation
Coal Seam
Soil Reclamation
Afforestation
Accounting/Aggregation
Wetlands Reclamation

SECARB

MVA Conceptual Plan

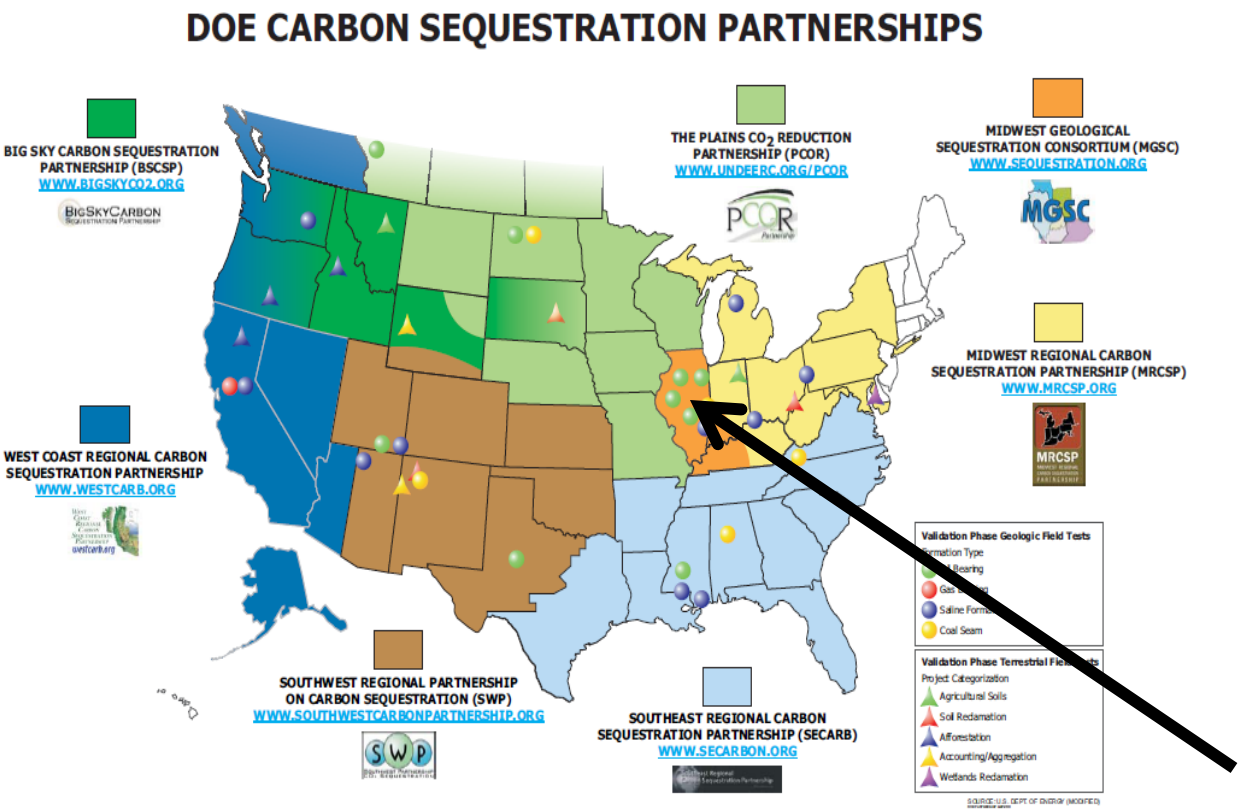


SW Partnership



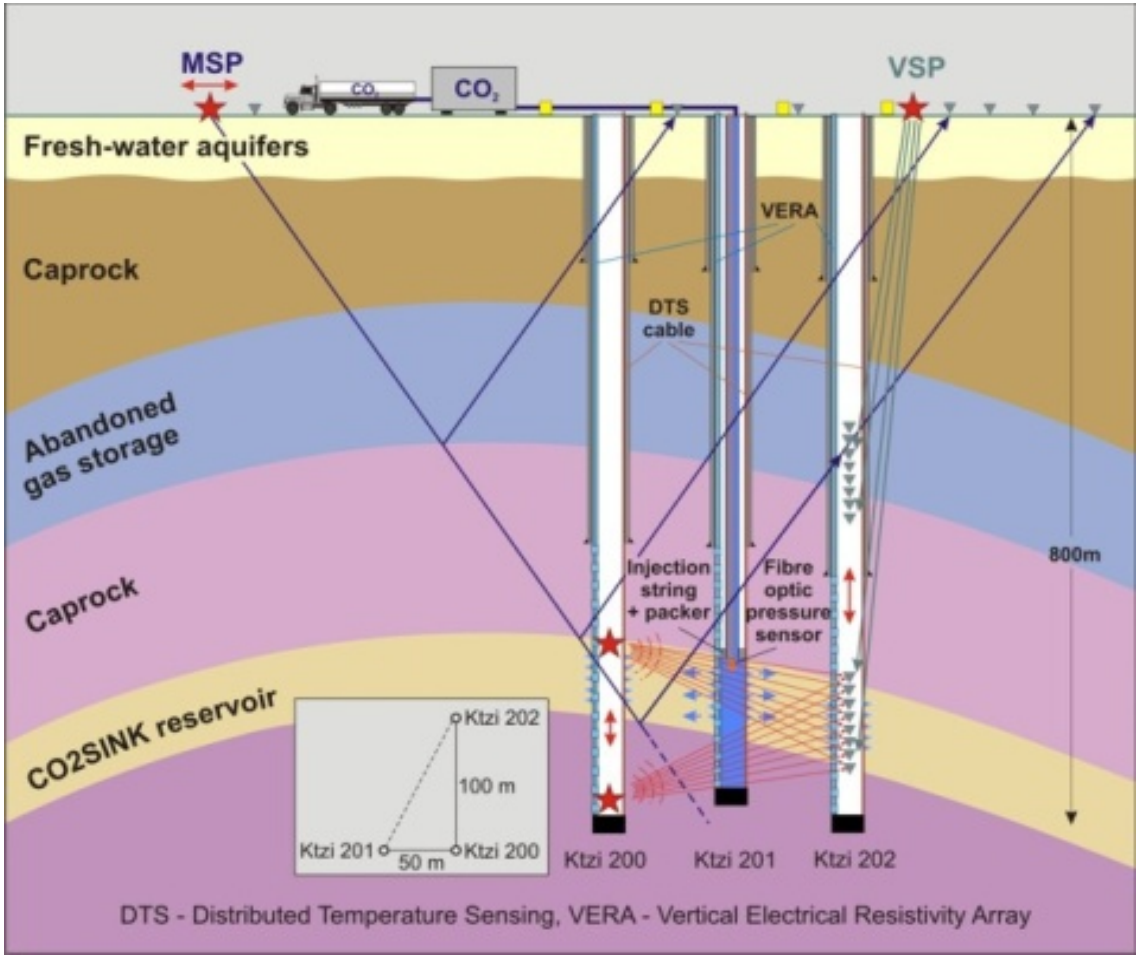
SW Partnership

Midwest Regional

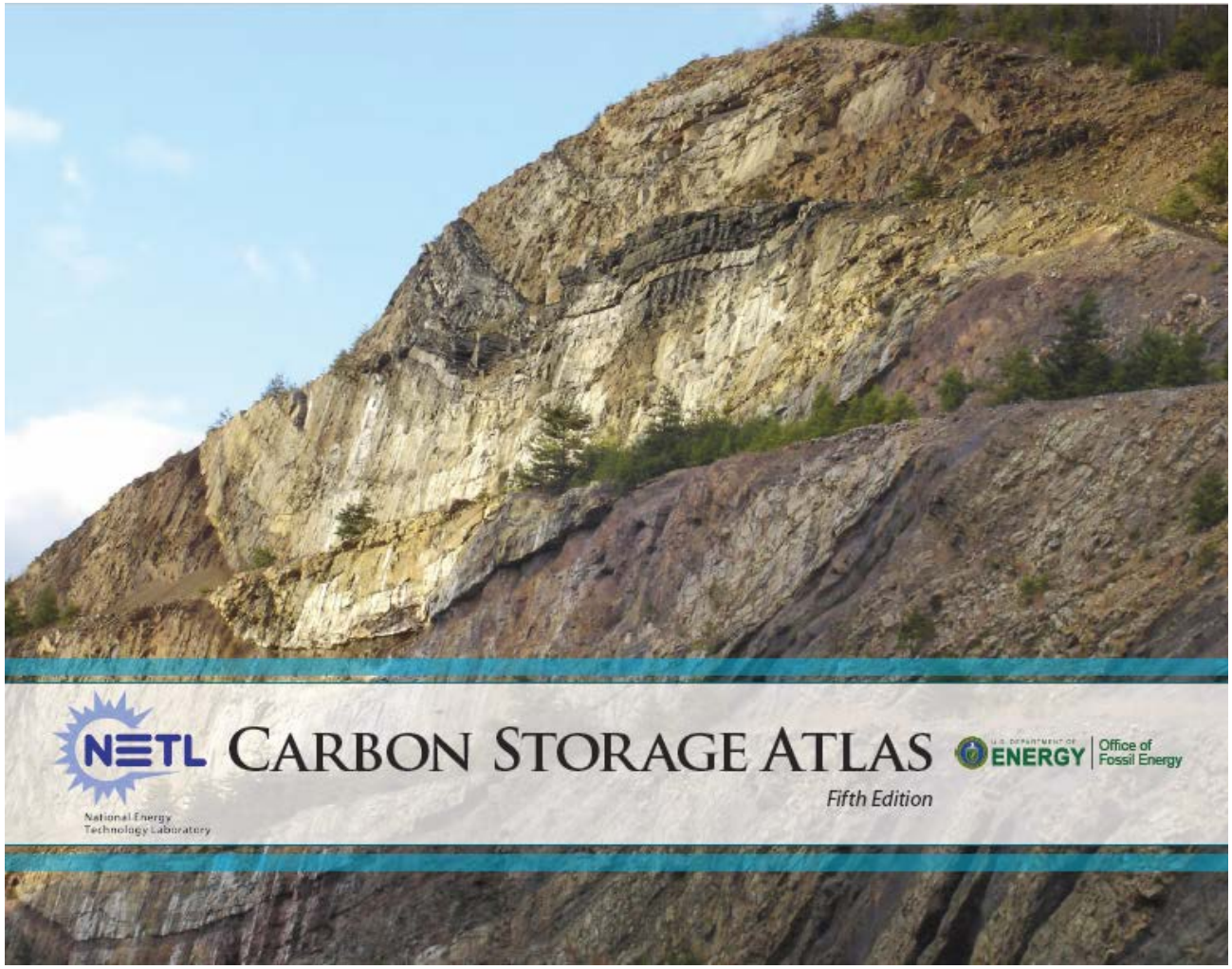


Midwest Regional

Ketzin (Germany) GFZ Potsdam



Resources



http://www.netl.doe.gov/research/coal/carbon-storage/atlasv

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Resources

https://www.netl.doe.gov/File%20Library/Research/Carbon-Storage/Project-Portfolio/BPM-MVA-2012.pdf

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Table 1: Field Readiness and Applicability of Monitoring Tools

Monitoring Approach		Field Readiness of Technology	Techniques	Applicability of Technology		
				UIC Class VI Rule	GHG Reporting Rule	Reservoir Management
Atmospheric Monitoring	Optical Sensors	Commercial Stage	CRDS, NDIR-based CO_2 sensors	✓	✓	
		Development Stage	DIAL/LIDAR	✓	✓	
	Atmospheric Tracers	Early Demonstration Stage	Passive tracer sampling (flask, sorbent)	✓	✓	
		Development Stage	Multi-tube remote samplers, wind-vane samplers	✓	✓	
	Eddy Covariance	Early Demonstration Stage	EC flux towers	✓	✓	
Near-Surface Monitoring	Geochemical Monitoring in the Soil and Vadose Zone	Commercial Stage	Flux accumulation chambers	✓	✓	
		Early Demonstration Stage	Soil-gas tracer sampling, soil-carbon analysis	✓	✓	
		Development Stage	Portable isotopic carbon analyzers, fiber optic sensors for soil-CO_2	✓	✓	
	Geochemical Monitoring of Shallow Groundwater	Commercial Stage	Shallow-groundwater sampling, geochemical analyses	✓	✓	
	Surface Displacement Monitoring	Early Demonstration Stage	Tiltmeters InSAR/PSInSAR, GPS	✓		✓
	Ecosystem Stress Monitoring	Early Demonstration Stage	Hyperspectral, multi-spectral imaging of vegetative stress		✓	

Litynski, J., Rodosta, T., and Brown, B., 2012, Best Practices for Monitoring, Verification, and Accounting of CO2 Stored in Deep Geologic Formations – 2012 Update, p.18.

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Conclusions

- CO_2 flux measurements can be an important part of a MVA protocol
- A baseline understanding of the ecosystem CO_2 flux is essential for any type of leak detection
- A combination of diurnal and spatial measurements can answer the background questions
- Public perception is very important

Thank You

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