Pressure Response Analysis and Area of Review Delineation at Potential CO_2 Storage Sites in Central Utah

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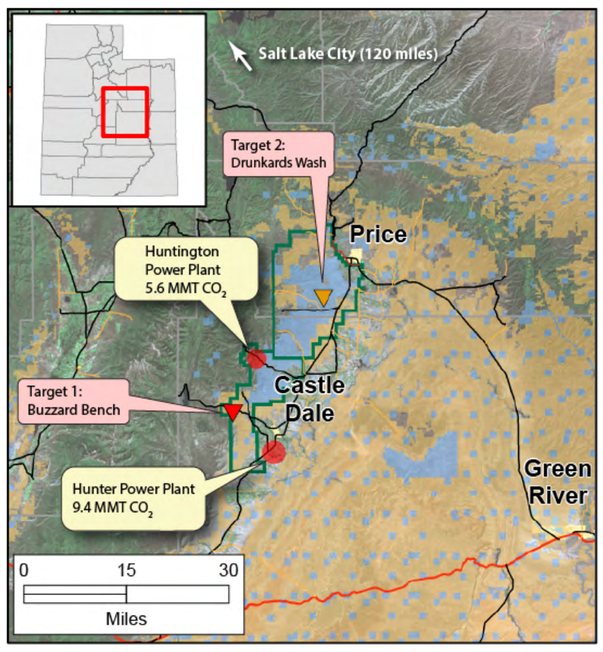
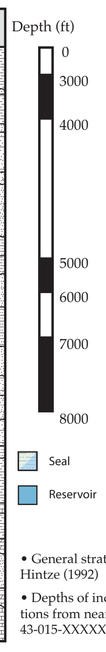
Abstract

This study investigates pressure buildup and Area of Review (AoR) at two possible CO_2 storage sites (Buzzards Bench and Drunkards Wash) in central Utah. Three uncertain parameters were considered in this analysis, including porosity and anisotropy ratio of storage formation, and injection rates. A total of 13 permutations were designed and simulated for each of the possible storage site to evaluate the pressure response during and after the injection. Simulation results were used to construct reduced order models (ROMs) with the response surface methodology (RSM) for further investigation of the pressure response of following Monte Carlo simulations. Moreover, with the aid of NRAP (National Risk Assessment Partnership) tools, simulated pressure and CO_2 saturation fields were used to define the AoR at both sites. It is observed that for both study sites, AoR defined by NRAP's Integrated Assessment Model (IAM) is smaller than the area with pressure buildup determined by reservoir simulations and ROMs.

Potential Storage Sites



Period	Formation / Member		Thickness (feet)	Depth (ft) @Hunter
CRET	Mancos Shale	Blue Gate Sh Mbr	300-1300	0
		Ferron Ss Mbr	10-110	3214
		Tununk Sh Mbr	400-650	3481
	Dakota Sandstone		150	4050
	Cedar Mtn Fm	Upper member	100-200	
		Buckhorn Cg Mbr	230	
JURASSIC	Morrison Formation		450	
	Summerville Formation		55	
	Curtis Formation		1102	
	Entrada Formation		1090	5626
	Carmel Formation		745	6375
	Navajo Sandstone		105	7258
	Kayenta Formation		370	
	Wingate Sandstone		265	
TRIASSIC	Chinle Formation		40	8534
	Moenkopi Fm	Upper member	380	
		Sinbad Ls Mbr	155	9192
		Black Dragon Mbr	300	
PERM	Black Box Dolomite		300	9570
	White Rim Sandstone		300	>9570
P	"Hermosa" Formation		450	
MISS	Madison Limestone		1200	



- General stratigraphy from Hintze (1992)
- Depths of individual formations from nearby well API# 43-015-XXXXX (near Hunter)

Methods

- ❑ Use **13** Eclipse simulations to "train" the ROMs
- ❑ Use the ROMs for simulating **500** realizations

Sim#	X1 (Porosity)	X2 (kz/kx)	X3 (Inj. Rate MT/yr)	Permeability (mD)	injection time (yr)
1	12%	0.05	2.5	17.16	20
2	20%	0.05	2.5	636.01	20
3	12%	0.5	2.5	17.16	20
4	20%	0.5	2.5	636.01	20
5	12%	0.275	1.67	17.16	30
6	20%	0.275	1.67	636.01	30
7	12%	0.275	5	17.16	10
8	20%	0.275	5	636.01	10
9	16%	0.05	1.67	131.24	30
10	16%	0.5	1.67	131.24	30
11	16%	0.05	5	131.24	10
12	16%	0.5	5	131.24	10
13	16%	0.275	2.5	131.24	20

- ❑ NRAP tools application

Petrel/Eclipse
- Build reservoir models for both sites
- Run numerical models

RROM-GEN
- Read Eclipse simulation results
- Post-process predictions of CO2 saturation and pressure

NRAP-IAM-CS
- Read RROM-GEN outputs
- Estimate risk-based AoR

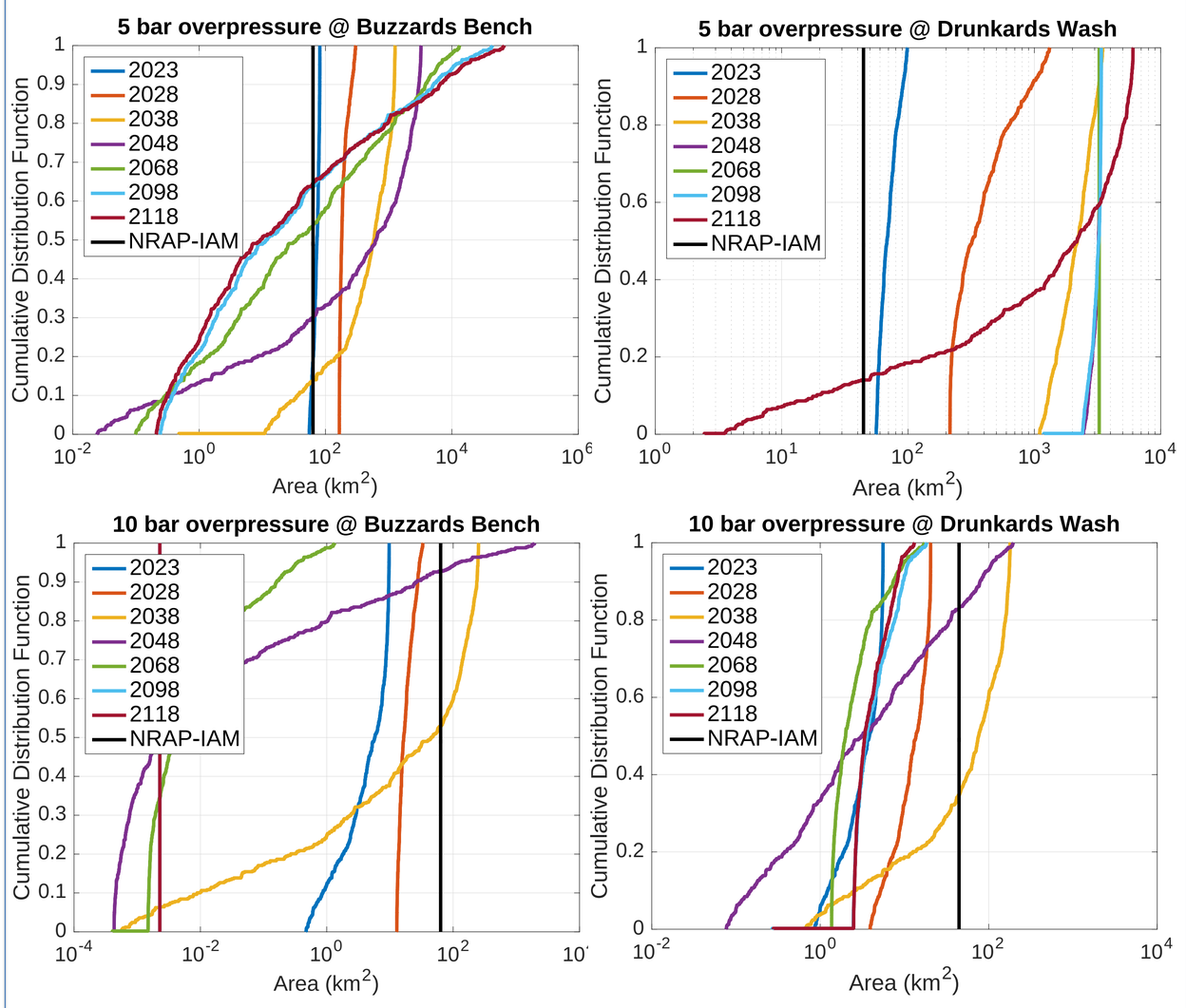
❖The Rocky Mountains CarbonSAFE Phase I project (DE-FE0029280) is supported by the U.S. Department of Energy through the National Energy Technology Laboratory.

Results & Discussion

❖ R^2 Between ROM Results and Eclipse Results

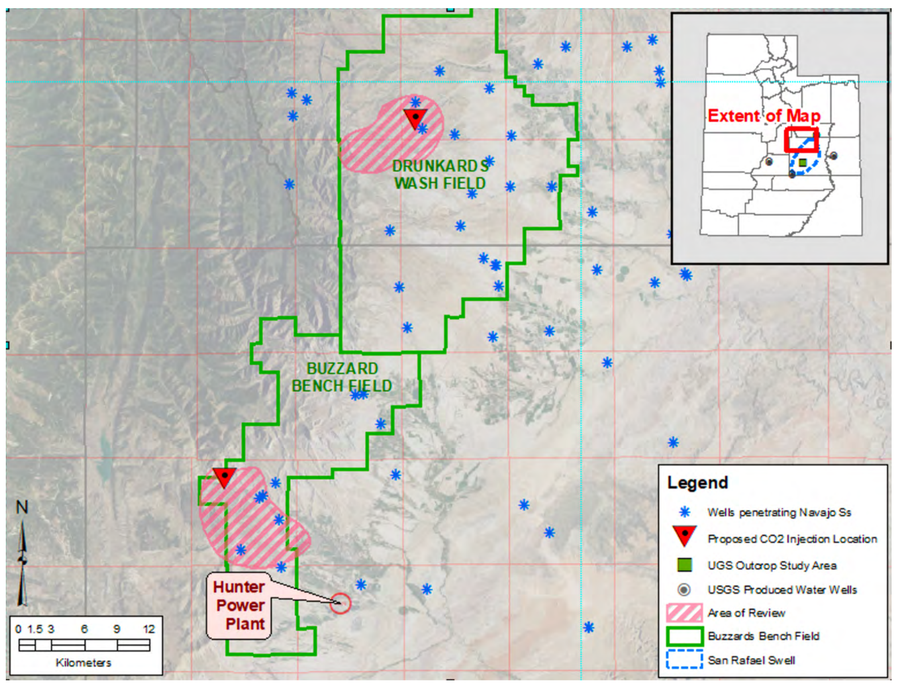
Case/Year	2023	2028	2038	2048	2068	2098	2118
5 bar @ BB	0.996	0.989	0.786	0.991	0.974	0.955	0.961
5 bar @ DW	0.985	0.983	0.959	0.903	-	0.704	0.697
10 bar @ BB	0.964	0.987	0.875	0.957	0.849	-	-
10 bar @ DW	0.956	0.942	0.969	0.779	0.917	0.848	0.866

❖ Pressure Response



❖ Risk-Based Area of Review

Outputs of NRAP-IAM-CS show that AoR at Buzzards Bench is 63.44 km^2, AoR at Drunkards Wash is 44.45 km^2.



Acknowledgement

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