Applicability of the Aquifer Impact Model to Support Decisions at a CO_2 Sequestration Site

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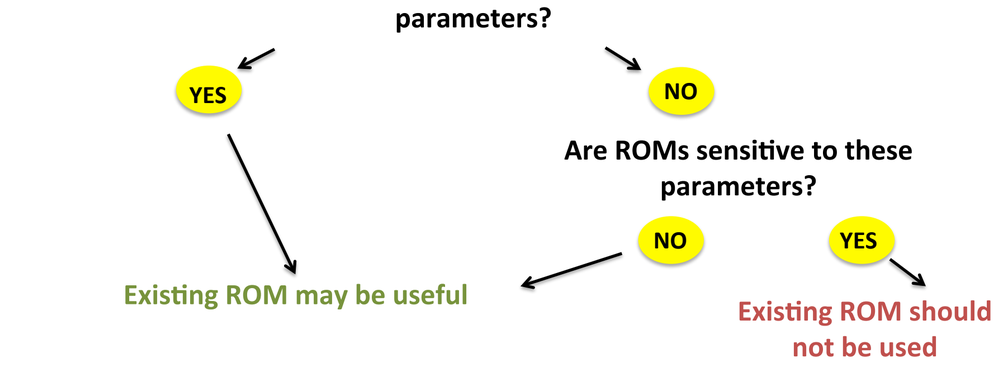
Aquifer Impact Model (AIM)

- AIM includes polynomial or look-up table based reduced-order models (ROMs) that predict the impact of CO_2 and brine leaks on overlying aquifers
- The ROMs in AIM
  - reproduce the ensemble behavior of large numbers of simulations
  - are well-suited to applications that consider the effect of parameter sensitivity and uncertainty on the risk of CO_2 leakage to groundwater quality
  - include adjustable input parameters so that they may be applied to other aquifers with similar hydrogeologic or geochemical characteristics

Criteria for Application of AIM to a New Site



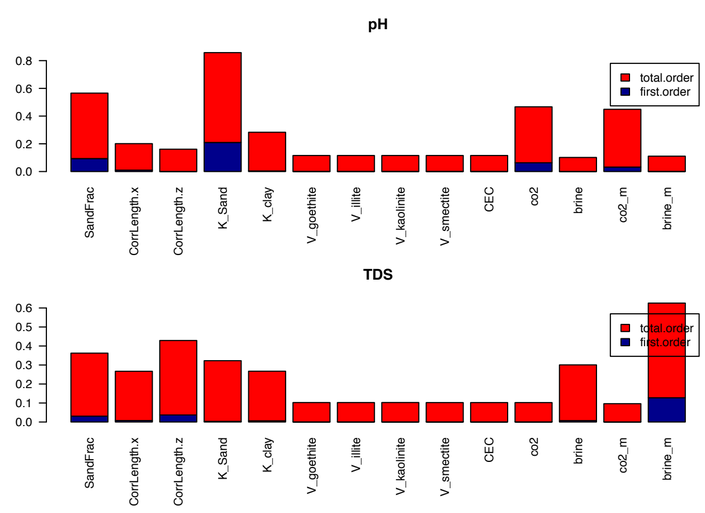
Comparison of Confined Alluvium ROM Parameters to Illinois Basin – Decatur Project Observations

	Parameter	Confined Alluvium ROM Parameters[1]	IBDP Pre-Injection Observations[2]	Parameter vs. Observations
Non-adjustable	Initial pH	7.6	7.31 (average)	Higher
	pH No-Impact Threshold	6.625	6.81 (5^{th} percentile)	Lower
	Initial TDS	570 mg/L	1152 (average)	Lower
	TDS No-Impact Threshold	1300 mg/L	1358 (95^{th} percentile)	Similar
Adjustable	Sand fraction	0.35 – 0.65	--	Uncertain
	Correlation length X	200 – 2,500 m	--	Uncertain
	Correlation length Z	0.5 – 25 m	--	Uncertain
	Permeability sand	10^{-14} – 10^{-10} m^2	$10^{-11.8}$ – $10^{-10.4}$ m^2	Within range
	Permeability clay	10^{-18} – 10^{-15} m^2	--	Uncertain
	Goethite volume fraction	0 – 0.15	--	Uncertain
	Illite volume fraction	0 – 0.2	--	Uncertain
	Kaolinite volume fraction	0 – 0.15	--	Uncertain
	Smectite volume fraction	0 – 0.3	--	Uncertain
	Cation Exchange Capacity	0.1 – 40 meq/100 g	--	Uncertain

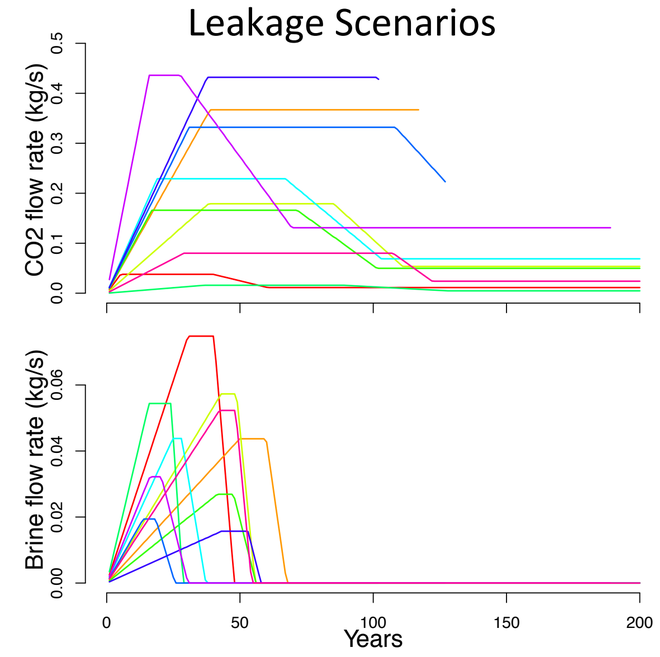
[1]Confined alluvium ROM chosen because of similarity in lithology between modeled sand and clay layers and glacial outwash deposits at IBDP site.

[2]Observations from monitoring wells ADM-G101, ADM-G102, ADM-G103, ADM-G104 between 8/12/2010 and 10/25/2011. Injection began in November, 2011.

Parameter Sensitivity



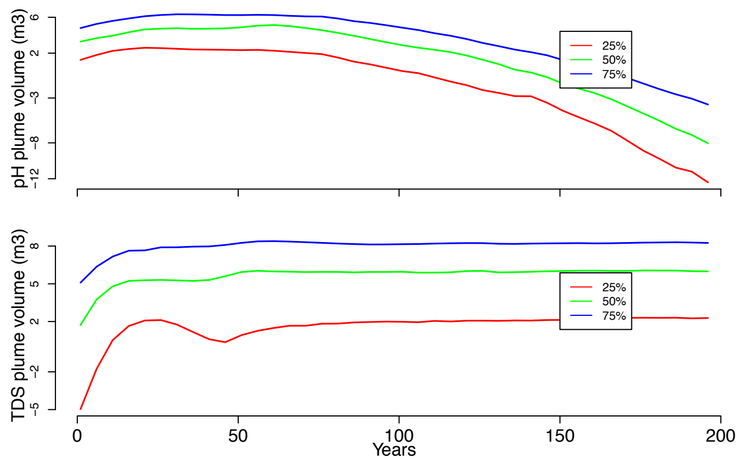
Leakage Scenarios



Conclusions

- Hydraulic parameters and source term magnitude are more sensitive than clay fraction or CEC
- More information on sand fraction and correlation lengths could reduce uncertainty
- Some non adjustable parameters are significantly different than observations

Aquifer Volume exceeding no-impact threshold (log scale)



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