

# Complexities

## dynamical model for CO<sub>2</sub> plumes

CO<sub>2</sub> monitoring w/ Data Assimilation is also complicated by

- ▶ complexity & nonlinearities of the *dynamics* & *measurement* models
- ▶ lack of knowledge on the reservoir properties (permeability)

Nonlinear multi-modal *dynamical* problem w/ control:

$$\mathbf{x}_k = \mathcal{M}_{k-1}(\mathbf{x}_{k-1}, \mathbf{K}; \mathbf{q}_{k-1}) \quad \text{with} \quad K \sim p(K)$$

$$\mathbf{y}_k = \mathcal{H}_k(\mathbf{x}_k) + \epsilon_k$$

- ▶ ***permeability*** is treaded as a *random variable* that can be *sampled*
- ▶ ***injection*** rates,  $\mathbf{q}_{k-1}$ , need to be *controlled* to avoid *fracturing* the seal
- ▶ well placement,  $\mathcal{H}_k$ , needs to be *optimized* to *reduce* uncertainty & costs

# Simulation-based inference