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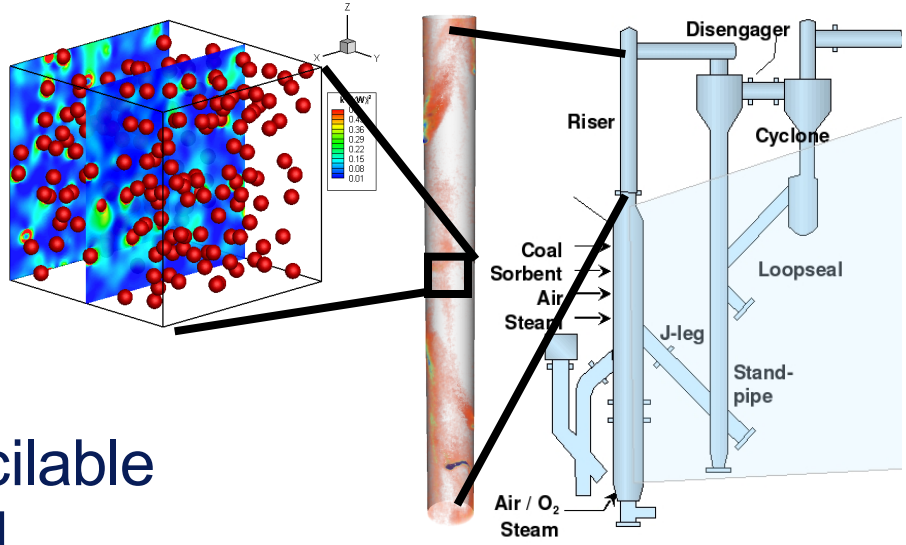
Analysis of dispersed multiphase flow using particle-resolved direct numerical simulation: flow physics and modeling

- ✓ Governing equations
  - ✓ capture all the details
- ✓ Solution method
  - ✓ PUReIBM: particle-resolved uncontaminated fluid reconcilable immersed boundary method



Wilsonville Coal Gasifier, *Guenther et al.*, 2002, www.mfix.org

- ✓ Challenge: Computational resources
- ✓ Solution: Simplifying equations with mathematical modeling
  - ✓ capture important information
- ✓ How to develop a model?

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High Performance Computing → Generating Data

- ✓ Larger domain is needed for some flow physics
  - ✓ Clustering of dispersed phase (solid particles)
- ✓ More equations should be solved for realistic problems
  - ✓ Heat equation
  - ✓ Species transport equation (Reacting Flows)

Data Science (Machine Learning) → Developing Model

- ✓ Discretization of equations on millions of grid
- ✓ Several quantities at each grid point