Seven Simplifications for Models of CO_2 Injection

Michael A. Celia
Department of Civil and Environmental Engineering, Princeton University, Princeton, NJ 08544
(celia@princeton.edu)

Jan M. Nordbotten
Department of Mathematics, University of Bergen, Bergen, Norway

Abstract. One attractive option to reduce carbon emissions to the atmosphere is carbon capture and geological storage, or CCGS. In CCGS, carbon dioxide from power plants is captured and subsequently injected into deep geological formations. This leads to a physical system in which multi-component, multi-phase flow occurs with geochemical reactions and complex phase behavior being additional potentially important processes. While the system is inherently complex, several characteristics and properties of the system make it amenable to simplification. We have cataloged seven simplifications that can apply to the injection portion of a CCGS operation. Application of some or all of the seven simplifications allows the mathematical description to be simplified, such that easier numerical calculations can be performed and, in some cases, analytical solutions can be derived. These simplifications can form the basis for large-scale simulations that focus on leakage of CO_2, migration and leakage of displaced brine, and an overall probabilistic risk analysis of the system. An example from Alberta, Canada demonstrates the potential utility of these simplified models.