Simulation of Geological CO2 Storage with the GEOS Open-Source Multiphysics Simulator

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Carbon capture and storage (CCS) is one of the most important technologies to achieve large-scale reduction in global carbon dioxide (CO2) emissions. The essence of CCS is to capture CO2 produced at power plants and industrial facilities and transport it to safe, permanent storage deep underground. Reducing CO2 emissions into the atmosphere is crucial to cut the carbon footprint of our society. The evaluation of CO2 storage candidate sites requires predictive simulation capabilities to assess site capacity and safety. We present an overview of the GEOS multiphysics simulation platform, an open-source simulator capable of serving as the computational engine for CCS evaluation workflows. We will discuss the development path of GEOS, and motivations to transition from a collection of smaller single-institution code development efforts to a multi-institution collaboration. We will describe the development of a discretization-data infrastructure, a standardized approach to solving single and coupled physics problems, and a strategy to achieve reasonable levels of performance portability across hardware platforms. We will outline the approach to documentation, and planned method of user interaction as the growth of that user base accelerates.