Performance and Performance Portability of the Albany/FELIX Finite Element Land-Ice Solver

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As HPC architectures become more heterogeneous, climate codes must adapt to take advantage of potential performance capabilities. This talk will focus on performance and performance-portability of the Sandia Albany/FELIX finite element land-ice solver. The computational time for an ice sheet simulation in FELIX is divided into 2 pieces, each comprising ~50% of the total run time: finite element assembly (FEA), and linear solves. We will discuss our efforts in transitioning the FEA in FELIX from an MPI-only to an MPI+X programming model via the Kokkos library and programming model. In this model, MPI is used for internode parallelism and X denotes a shared-memory programming model for intranode parallelism (e.g., X=OpenMP, CUDA). With Kokkos data layout abstractions, the same code can run correctly and efficiently on current and future HPC hardware with different memory models. Also described in this talk will be our scalable and robust algebraic multigrid-based iterative linear solver, developed specifically for large-scale ice sheet problems. Perspectives for integrating Kokkos into this solver, towards making it performance-portable, will be given.