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Plasma simulations with a domain-hybridized model I. A. M. DATTA, U. SHUMLAK, University of Washington — High-fidelity simulations of plasma dynamics can involve various mathematical formulations, including the single fluid magnetohydrodynamic model, the multi-species (electrons, ions, and neutrals) $5N$-Moment fluid model, and the continuum kinetic model. While it is common for simulations to use a single formulation to study the plasma dynamics, local plasma properties such as the degree of magnetization, charge separation, and collisionality can make certain formulations more appropriate than others in different regions of a simulation domain. Examples include fluid simulations involving sheaths where kinetic effects become important. The goal of this work is to combine these models in a single domain-decomposed hybrid model where multiple formulations are used in a single simulation. The work focuses on development of the interface boundary conditions between formulations and determination of the parameter regimes most appropriate for each to maintain sufficient physical fidelity over the whole domain while minimizing computational expense. The WARPXM framework developed at the University of Washington which implements these formulations using a discontinuous Galerkin spatial discretization on unstructured meshes is being used to develop the domain-decomposed hybrid model.

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