PHARE: Modeling planetary magnetospheres with Adaptive Mesh and Model Refinement

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Résumé

Understanding the global dynamics of a magnetosphere and its coupling with its environment is challenging due to the multi-scale nature of the problem. Kinetic models are computationally expensive, while fluid models lack realism.
We present progress on a next-generation simulation framework using the open-source PHARE code, with Adaptive Mesh Refinement (AMR) solvers for two complementary formalisms: Hall-MHD (fluid) and Hybrid Particle In Cell (kinetic). These solvers have been validated and used for large scale simulations of magnetic reconnection.
The next step is Adaptive Mesh and Model Refinement (AM2R), which enables both descriptions to run simultaneously within a single global magnetospheric simulation, refining the mesh and the physical model only where needed. We show current progress toward this fluid–kinetic coupling and discuss its application to planetary magnetosphere modeling.

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