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Multi-level multi-domain simulations: a new approach to multi-scale multi-physics descriptions ARNAUD BECK, M.E. INNOCENTI, GIOVANNI LAPENTA, KU Leuven, STEFANO MARKIDIS, KTH — There are a number of modeling challenges posed by space weather numerical simulations. Most of them arise from the multi-scale and multi-physics aspects of the problem. The multiple scales dramatically increase the requirements, in terms of computational resources, because of the need to carry large scale simulations with the proper small-scales resolution. Lately, many suggestions have been made to overcome this difficulty by using various refinement methods which consist in splitting the domain into regions of different resolutions. The multiple physics are generally treated in a similar way: interfaces separate the regions where different equations are solved. We present here an innovative approach based on the coexistence of several levels of description, which differ either by their resolutions or by their physics. Instead of interacting through interfaces, these levels are all entirely simulated and are interlocked over the complete extension of their overlapping area. This scheme has been applied to a two-dimensional implicit Particle in Cell code. Some results of magnetic reconnection simulations are presented and we also discuss the optimal implementation of this scheme on very large clusters.

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