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Recent advancement in particle-in-cell simulations in geosciences

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This paper gives a review on the recent advancement in particle-in-cell simulations in the geoscience community. The recent development of supercomputers allows us to perform large-scale and massively parallel computer simulations. In the geosciences community, collisionless shocks, magnetic reconnection, and MHD-scale turbulence (such as Kelvin-Helmholtz instability) are of interest as cross-scale coupling processes between particle kinetics and fluid dynamics. The cross-scale coupling is a fundamental process, which large-scale fully kinetic simulations are essential to understand. We will give advanced numerical techniques and latest simulation results on the cross-scale coupling.

Keywords: plasma, computer simulation, particle-in-cell simulation, simulation technique, cross-scale coupling