Geospace Environment Simulator Project

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The Earth Simulator with computing capability of 40 terra-flops and a huge main memory of 10 terra bytes give us a unique opportunity to challenge a large scale simulation with can reproduce a realistic physical model that can be utilized for studying the geospace environments for various human activities in the future. Our goal is to reproduce various physical processes in the Earth's magnetosphere, such as formation of shocks, discontinuities and current layers, acceleration of particles, magnetic reconnection, acceleration of particles, and excitation of electrostatic and electromagnetic waves in association with dynamics of the whole magnetosphere due to variation of solar wind conditions. Depending on different spatial scales and time periods of the magnetospheric phenomena, we apply the electromagnetic particle code, hybrid code or MHD code to realistic three-dimensional models. The electromagnetic particle code solves motions of individual electrons and ions along with Maxwell's equations. It is especially useful for investigation of microscale electromagnetic environment surrounding spacecraft, which can only be tested numerically in advance, because spacecraft is too large to be tested in laboratory chambers on the ground. The hybrid code treats electrons as a massless fluid, while solving motions of ions. The MHD code treats the plasma as a single fluid described by magneto-hydro dynamics. The database of three-dimensional models contributes to better understanding of the fundamental processes of the magnetosphere, designs of future satellite projects, and estimation of electromagnetic environment for utilization of geospace. We will report our initial efforts in making use of the full capability of the Earth Simulator by vector-parallel programming based on HPF and MPI.