Visualization for Large-scale Eruption Cloud Simulations using MovieMaker

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During explosive volcanic eruptions, a mixture of volcanic gas and solid pyroclasts is ejected from the volcanic vent and entrains ambient air. The mixture of the ejected material and entrained air (i.e., eruption cloud) is characterized by a multi-dimensional and unsteady flow structures because of the nonlinear feature of the density change and the stratified environment. The heavy ejected material collapses to the ground and spread radially as a pyroclastic flow. As it rises and entrains ambient air, the density of the cloud becomes less than that of air and a buoyant plume develops as an eruption column. When the eruption column exhausts its thermal energy and loses its buoyancy, within the stratified atmosphere, the eruption cloud spread radially as an umbrella cloud. In order to reproduce and predict the quantitative features of eruption cloud, we carried out the 3-D numerical simulations and visualized their results.

The numerical model is based on the work of Suzuki et al. [2005]. We visualized the results of eruption cloud simulation using MovieMaker. MovieMaker is the high performance parallel software of master-slave mode to visualize for the large-scale data output with the earth simulator. The master process does reading configuration file, storing the simulation data and parameters to shared memory, and assigning of visualization tasks to the slave processes. The slave processes visualized the data by assignment with the master process. These images were gathered up via shared memory and merged as conclusive result at master process. By using this software, users can use three visualization method, volume rendering, iso-contouring and streamline, to simulation data. In these parallel rendering systems, the time for reading data is critical issue for performance of the software. In MovieMaker, the processing time for reading data in the master process is overlapped with the processing time for rendering on the slave processes. Furthermore, the master process does dynamic load-balancing of rendering process, when it assigns rendering tasks to the slave processes.

We carried out the simulations of large-scale eruptions such as the Pinatubo 1991 eruption and visualized some key parameters such as a mass fraction of the ejected material, density, pressure, and temperature. We visualized the data by using the volume rendering function of MovieMaker. In the case of using monochrome color map, visualized simulation results were represented like as real eruption clouds, and we can compare these images with the satellite images. In the case of using RGB color map, we also visualized three dimensional inner structures which are difficult to observe directly. In the presentation, we will report visualization results of large-scale eruption clouds simulation.