

## Three-dimensional visualization and representation of simulation data with the Earth Simulator

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By the remarkable performance improvement with super computers such as Earth Simulator, we have been able to achieve a high resolution simulation which outputs data more than the order of GB. Under these circumstances, there is an urgent need for revolution in techniques or the fundamental ideas of analysis and visualization.

It is evident that there is a need in high-performance system for analysis to process mass data by the high resolution simulation. However, there is a limit in ability on the human side to extract phenomena from highly complex data, even if the system is arranged to deal with such data. For instance, when one simply cut down data, which composes a front side layer to see the interior phenomena hidden on the multilayer structure, it becomes difficult to find the correlation between the interior side and its around. In the case of simulations of turbulent flow intertwined complicatedly, the intertwined aspect might be lost when data are thinned out. For such results, making the isosurface to translucent, the volume rendering and so on are effective methods for visualization of the current use. However, the effectiveness of these methods is lost when they are used repeatedly.

Up to now, a lot of styles for visualization have been done by only seeing a two-dimensional image projected on the surface where its normal direction is defined as the direction from the outside of the space that data produces to the inside. In other words, it can be said that it reaches a methodological limit to understand the meaning of highly complex data. The way which we not only look down the world represented by data from the outside but also look out from the inside by entering into it virtually and making our eyes move freely, it can be one of effective methods to lead fresh discoveries from highly complex data.

Moreover, it has been able to reproduce the natural phenomena more realistically as the resolution of the simulation becomes higher. That is, not only data is shared among some special researchers but also people become easy to understand its meaning in the sense. However, an advanced representation techniques in visualization is essential.

Based on the above, we are researching by focusing on the methods of representation in the visualization of mass data. First, we will show some real CG animations (produced by NHK) in each simulation of a high resolution with the Earth Simulator for the atmospheric and the oceanic circulation. Secondly, we will show the video of the earth's magnetic field generation simulation analysis by the three-dimensional immersive visualization system which we have been working on for the advanced representation of visualization. Finally, we will show some image and animation contents about the visualization result of the coupled atmosphere-ocean simulation by the parallel-processing visualization tools where large-scale data of the order of GB or higher is able to be visualized at high speed in the meaning of practical use.