Visualization method based on the light transport for clouds using Super-Droplet Method

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A cloud is one of the most familiar meteorological elements, which is commonly seen. It plays also the key role in various phases of climate and weather systems, as not only rainfall and insolation, but also the radiation budget of the atmosphere thought to be related to the global warming.

To simulate faithfully a cloud nature, we have developed an innovative concept which is called a Super-Droplet (SD). We have applied it to the cloud micro-physics model, and developed the cloud formation simulation model composed of it and the non-hydrostatical climate model. We have also tried to develop several visualization methods for the cloud and the rainfall, based on the spatial and the radii distributions of the droplets accurately given by the SD method.

A photo-realistic representation of clouds, which considers the radiative transfer of light, is one of the most challenging works as the attempts of visualization. The scattering of light by cloud particles is strongly characterized by the distribution of their radii. Therefore, that visualization method enables us to obtain the picture similar to actual clouds and rainfalls, since the light entering into the cloud is intricately and multiply scattered and emitted out of it. Moreover, the appearance that insolation changes according to the cloud growth can be also visualized by this method.

To visualize such the clouds with little calculation cost, we use the following methods: the Monte Carlo photon tracing for the multiple light scattering processes, the volume photon mapping for the indirect illumination effect by in-scattered photons, and the ray marching for the final gathering (rendering). Details for these methods, current status of our development and several kinds of visualization results by these methods will be presented in this talk.