Visualization of Three-dimensional Temperature distribution in Google Earth

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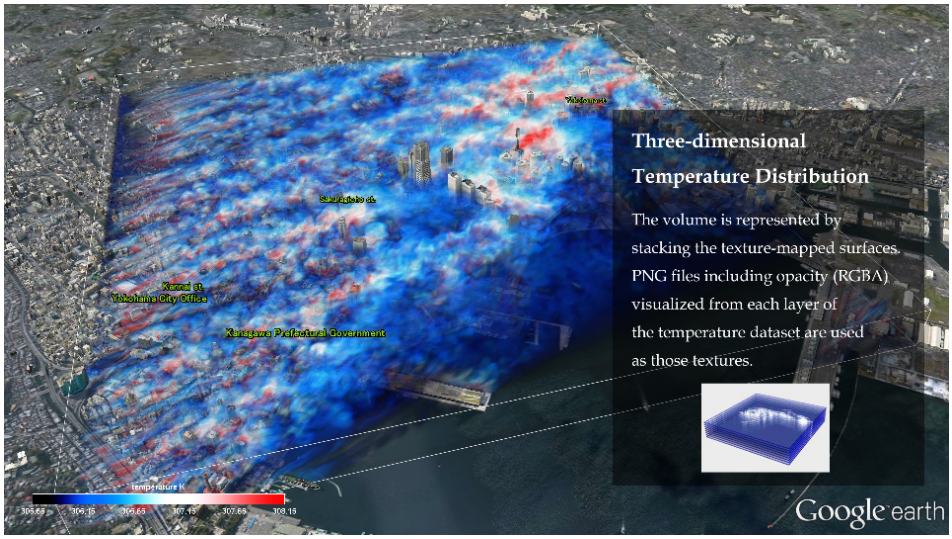
The graphical contents described on Google Earth are mainly classified according to a number of spatial dimensions from zero to two (2D): the point source of an earthquake-epicenter, the curves of cruising-track, and the surface of satellite image are examples on the geo-scientific topics. This classification below 2D comes from that Keyhole Markup Language (KML) used in Google Earth does not support three-dimensional objects except the statistical charts or the model buildings. Therefore, a new idea is expected to describe the three-dimensional contents, especially obtained from numerical simulations in which the data are defined on spatially three-dimensional grids.

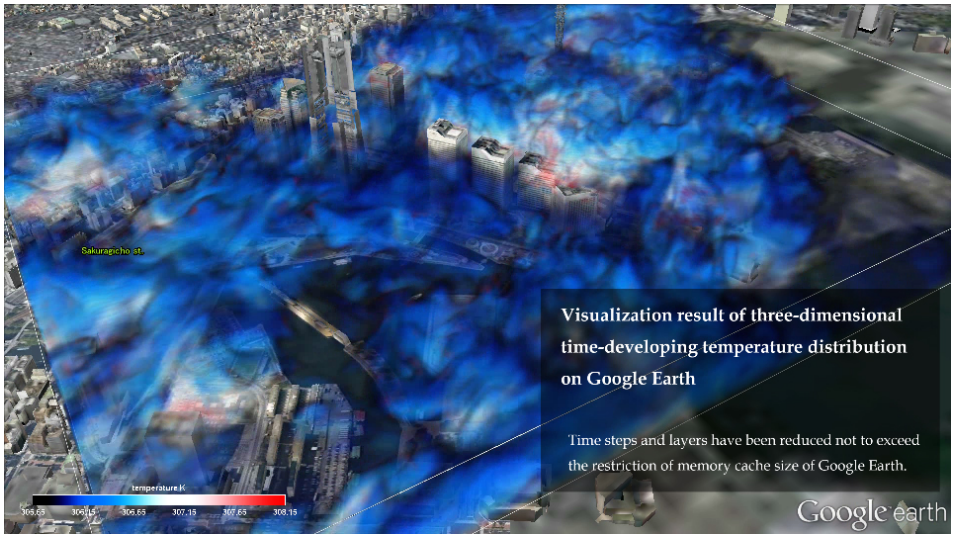
Here we propose a novel technique to represent the three-dimensional scalar data on Google Earth. The key is opacity. Appropriate value of the opacity is assigned to data. As a result, we can easily see multiple data aligned the view direction. We select PNG image-format because the alpha channel for opacity is supported.

The simulation is performed on Earth Simulator using the urban-scale atmospheric simulation model called the Multi-Scale Simulator for the Geoenvironment (MSSG). The shown dataset is the three-dimensional, time-developing temperature distribution in the area of about 4km-square in Minato Mirai 21 district, Yokohama, Japan, The spatial resolution is about 5 meter (~ 0.000045 degree) with the grid number of 968 (longitude) x 792 (latitude) x 82 (layers). The calculated time is 30 minutes with interval of 10 seconds. We successfully obtain quite nice visualized movie which is similar to the volume rendering method.

Calculation area (Minato Mirai district, Yokohama, Japan) and conditions of the simulation



3D view from the east side of the simulation result (volumetric representation of temperature distribution)



The time evolution of the temperature distribution