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LES of flow and plume dispersion in an actual urban area

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There is a potential problem that the intentional release of radioactive materials by terror attacks and the accidental spillage from the transportation or storage of flammable and toxic gas occur within populated urban area. For the assessment of human health hazard or the safety analysis of the hazardous gas, not only mean but also fluctuating concentrations should be estimated. Therefore, we have developed a high resolution atmospheric dispersion model using Large Eddy Simulation (LES) model and perform its simulation on plume dispersion in an actual urban area (Oklahoma city) and investigate the characteristics of mean and fluctuating concentrations.

The basic equations for the LES model are composed of the spatially filtered continuity equation, Navier-Stokes equation and transport equation of concentration. The standard Smagorinsky model (Smagorinsky, 1963) is used and its constant is set to 0.1 for estimating the eddy viscosity. The turbulent Schmidt number is 0.5. In our LES model, two computational regions are set up. One is a driver region for generation of inflow turbulence and the other is a main region for LES of plume dispersion in an actual urban area immersed in the atmosphere boundary layer. First, inflow turbulence is generated by using Kataoka's method (2002) in the driver region and then, its data are imposed at the inlet of the main computational region at each time step.

We can capture the unsteady behaviors of turbulent flow and plume dispersion within and over an actual urban area and show the spatial distribution of mean and fluctuating concentrations.

Keywords: LES, plume dispersion, actual urban area